BULLETIN NO. 18—NEW SERIES.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF ENTOMOLOGY.

SOME

MISCELLANEOUS RESULTS

OF THE

WORK OF THE DIVISION OF ENTOMOLOGY.

III.

PREPARED UNDER THE DIRECTION OF
L. O. HOWARD,
ENTOMOLOGIST.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1898.

DIVISION OF ENTOMOLOGY.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF ENTOMOLOGY,
Washington, D. C., November 1, 1898.

SIR: I have the honor to transmit herewith the manuscript of a bulletin which contains matter similar to that published in Bulletins Nos. 7 and 10 of the new series, namely, miscellaneous articles and notes which are too short for separate publication but which are of such importance that they should be promptly printed. I recommend the publication of this manuscript as Bulletin 18, new series, of this Division.

Respectfully,

L. O. HOWARD,
Entomologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

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INTRODUCTION.

The present bulletin is the third of the new series of this Division to contain miscellaneous short articles and notes. It presents a number of articles of more than usual interest. The record of experiments on drying fruit affected by the San Jose scale is of international importance in view of the recent legislation by foreign countries barring American dried fruits from entrance. The account of the work against the fluted scale, *Icerya purchasi*, in Portugal contains another striking example of the value of the study of natural enemies of injurious insects. The articles by Mr. Chittenden on twig pruners and a new borer enemy of the birch are of interest on account of the recent damage by these destructive insects and of importance since they bring to notice some species new to this form of damage. The peach Lecanium article by Mr. Pergande will, it is hoped, settle the long-mooted question as to the identity of the brown scale which so frequently damages peach trees, and that upon a new Coccid on birch describes with great care the life history of a remarkable insect which has ruined the bark of the beautiful white birch over a large extent of the Lake Superior region. The periodical Cicada articles by Mr. Marlatt are also of special interest, the first one proposing for the first time a rational nomenclature for the different broods of this unique insect.

L. O. H.

SOME MISCELLANEOUS RESULTS OF THE WORK OF THE DIVISION OF ENTOMOLOGY.

THE SAN JOSE SCALE ON DRIED FRUIT.

By L. O. Howard.

We have made little mention as yet in the publications of the Division of the recent actions by foreign governments in prohibiting the importation of American plants and fruits on account of the danger of introducing the San Jose scale. In Bulletin 12, new series, we gave the German edict of February 5, which prohibited living plants and their packing as well as fresh fruit when examination of the latter indicated the presence of the scale. A later edict included fruit waste (cores and skins), a by-product of evaporated apples. Still later, customs authorities were notified to allow the importation of whole unpeeled dried fruit from the United States without previous examination for the presence of the San Jose scale only when, without exception, it is wholly dry, hard, and brittle, so that without difficulty it can be rubbed fine in the hand.

Measures adopted by the Austro-Hungarian Government in April were prohibitive only in so far as related to the importation of living plants, grafts, and layers, and also the packing and cover with which they were shipped. Measures adopted about the same time by the Canadian Government prohibited only nursery stock. A comprehensive law adopted by the Government of the Netherlands did not take action regarding dried fruit, the minister of the interior stating in the discussion of the bill that he did not consider such a course necessary.

On the 14th of July the Federal Council of Switzerland promulgated a decree which in effect prohibited the importation into that country of all unpeeled American dried fruits. This decree, apparently working a hardship upon American exporters, has been the subject of a somewhat extensive correspondence, in the course of which the United States Department of State was appealed to by American exporters, and in turn the United States Department of Agriculture was consulted for expert information. The Divisions of Pomology and Entomology were consulted by the honorable Secretary of Agriculture, and extracts from the reports of these divisions follow.

FROM THE DIVISION OF POMOLOGY.

Under this enactment it would appear that all American unpeeled sun-dried or evaporated fruits are denied entrance to Switzerland. This practically shuts out all American sun-dried or evaporated plums, prunes, apricots, nectarines, cherries,

raisins, and berries, all of which fruits are commonly dried without being peeled, as well as evaporated apple "chops" and "skins," which are largely exported to European countries. It also affects the trade in both sun-dried and evaporated peaches and pears, of which only a part of the product consists of peeled fruit.

The avowed intention of the prohibition, according to the press reports, is to prevent the introduction of San Jose scale on such fruits.

In the absence of any recorded instance where this scale has been introduced to any fruit region through the agency of infested fresh fruit, the prohibition of the importation of the dried product seems unnecessarily severe. All American sun-dried fruits are subjected to a high temperature in the open air for several days during the drying process, and it is very doubtful whether the scale could long survive such treatment. If there is any doubt concerning such fruit it could easily be removed by requiring that all sun-dried fruits should be sterilized before packing, by being heated in a fruit evaporator, to a temperature to be agreed upon by test, for such length of time as would be sufficient to destroy all living scale, if such were present.

In so far as it relates to evaporated fruits the prohibition is entirely unnecessary. In the evaporating process the fruit is subjected to a temperature of 150° to 200° F. for several hours, usually twelve or more. In the case of apricots, peaches, and pears, the fruit is subjected to the fumes of burning sulphur for from thirty to sixty minutes before being placed in the evaporator. In California the same treatment is applied to fruits that are afterwards dried in the sun, while in all prune-growing districts of the United States the fruit is dipped in hot lye to check the skin and hasten the drying process. This treatment undoubtedly destroys the life of any scale that may be upon the fruit.

In view of these facts, which are capable of the most complete substantiation by observation in the portions of the United States which produce the dried and evaporated fruits mentioned, it is my opinion that a strong protest should be made by the Department of State against the continuance of the above-mentioned prohibitive legislation.

As it now stands, it unnecessarily and unjustly restricts legitimate trade in an important pomological product.

Very respectfully,

WM. A. TAYLOR,
Acting Pomologist.

FROM THE DIVISION OF ENTOMOLOGY.

From an intimate acquaintance with the habits and life history of the San Jose scale, extending now over a period of nineteen years, or ever since it was first discovered in the United States, I can, with confidence, state that, in my opinion, the Swiss legislation works an entirely unnecessary hardship upon American exporters of dried fruits. With regard to evaporated fruits, the prohibition is ludicrously unnecessary. With regard to sun-dried fruits, it is my strong belief that it is equally unnecessary.

I have seen the newspaper statement to the effect that the San Jose scale in living condition has been found upon the skin of American dried fruit imported into Germany, but firmly believe that this is a misstatement, and am of the opinion that the State Department would be perfectly justified in any endeavor to secure a modification of the Swiss ruling, and would indorse the suggestion of the Acting Pomologist that, in case it should be found that it is impossible to secure the entire abolition of the ruling, in all fairness efforts should be made to remove evaporated fruits from the prohibited category and to secure the admission of sun-dried fruits which have been sterilized before packing.

Respectfully yours,

L. O. HOWARD,
Entomologist.

Although the Acting Pomologist and the Entomologist were so confident of the correctness of their views, as expressed above, that experimentation seemed hardly necessary, it was decided, in order to lend force to subsequent expressions of opinion by the Department, to undertake a series of experiments with sulphured and unsulphured sun-dried and evaporated fruits of different kinds, including apples, pears, and peaches, all well infested with the San Jose scale, and these were carried out during the months of September and October.

Through the kindness of Dr. J. B. Smith, of New Brunswick, N. J.; Prof. G. H. Powell, of Newark, Del.; Prof. W. G. Johnson, of College Station, Md., Prof. W. B. Alwood, of Blacksburg, Va., and Mr. E. Dows, of Riverside, Md., the writer was able to secure the desired fruit, viz, apples, pears, and peaches, all bearing a greater or smaller number of living specimens of the San Jose scale. Some of the fruit was badly infested, while other specimens carried but a few scales. This fruit was turned over to Mr. Taylor, who sliced and dried it by both evaporating and sun-drying processes in accordance with the general customs, having dried a certain amount of each without previous sulphuring and submitting the rest to the ordinary sulphuring process. The lots of fruit were kept distinct, and the dried product was returned by Mr. Taylor to this Division. On receipt at this office the entire product was carefully examined. Each section of dried fruit was examined with a hand lens to locate the scales, and each scale found was examined under a compound microscope in order to ascertain whether it was living or dead. The examination was necessarily protracted and very tedious, but, in a word, not a single scale was found which showed the slightest signs of life.

We consider this test to have been conclusive and to have demonstrated that prohibition of American dried fruit by foreign countries is unnecessary in order to protect their fruit-growing interests, and that the complaints of American exporters are fully justified. The details of the experiments follow, the reports of the evaporation experiments being signed by Mr. W. A. Taylor, Acting Pomologist, who personally conducted the work, assisted by Messrs. W. P. Corsa and W. N. Irving, of the Division of Pomology, and the results of the entomological examination being signed by Mr. Nathan Banks, an expert assistant in the Division of Entomology, who conducted the microscopic examination of the scales. Mr. Banks's methods and results were tested by the writer and found to be perfectly satisfactory.

EXPERIMENT I.—EVAPORATION OF ANGOULEME (DUCHESS) PEARS, SEPTEMBER 13, 14, 1898.

These pears were "shipping ripe," rather immature to evaporate to good advantage. They were divided into two equal lots, A and B, by weight, and were then quartered, cored, and placed on trays.

Lot A was spread upon two trays (1 and 2) and exposed to the fumes of 1 teaspoonful of sulphur for fifteen minutes in the bleaching box, which has a capacity of four

trays. They were then placed in the evaporator, No. 1 on the bottom ledge and No. 2 on the seventh ledge from the bottom.

Lot B was spread upon two trays (3 and 4) and immediately placed in the evaporator, No. 3 on the fourth ledge and No. 4 on the top or tenth ledge.

Temperatures were observed continuously by means of mercurial thermometers placed on bottom and top trays, with tubes extending out through small holes in side and top of evaporator. Temperatures were recorded at intervals of fifteen minutes. The evaporator was opened at intervals of one hour to observe the condition of the fruit. After five hours of continuous heat it was decided that it would be necessary to divide the quarters into eighths, which was done to hasten completion of the process. At the end of nine hours all but the largest pieces were pronounced cured and were removed from the evaporator. The remainder were left in two hours longer.

The temperature of the bottom tray during the process (with exception of short periods after the opening of the evaporator for inspection) ranged from 73° C. to 100° C., the latter temperature continuing but for a few moments on two occasions. It was found necessary to check the fire frequently to prevent a higher temperature, and as commonly operated the lower tray is undoubtedly subjected to a temperature several degrees higher than it was during this test. A temperature of 90° to 98° C. on the bottom tray was maintained during most of the period, 94° being the temperature sought.

The temperature of the top tray under similar conditions ranged from 10° to 20° C. lower than that of the bottom tray, the maximum temperature of the top tray being 88°.

The fruit on this tray cured much more slowly than on the bottom tray because of the lower temperature.

Gross and net weights of fresh fruit and weights of cured fruit.

	Weight.		Cured in—		Total.
	Gross.	Net. *a*	9 hours.	11 hours.	
Lot A:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tray 1	12. 20	11. 69	1	0. 16	1. 16
Tray 2			1. 19	0. 34	1. 53
Total cured fruit, lot A					2. 69
Lot B:					
Tray 3	12. 20	11. 72	0. 93	0. 34	1. 27
Tray 4			0. 78	0. 76	1. 54
Total cured fruit, lot B					2. 81

a After removal of cores and waste.

W. A. TAYLOR,
Acting Pomologist.

I have found all the scales in this lot dead.

NATHAN BANKS.

EXPERIMENT II.—EVAPORATION AND SUN DRYING OF BEN DAVIS AND BALDWIN APPLES.

On September 15, 1898, a mixed lot of Ben Davis and Baldwin apples, infested with San Jose scale, was divided into two equal parts, A and B, by weight. Each lot was sliced into eighths, without paring, and spread upon trays.

Lot A was spread upon trays 5 and 6 and exposed to the fumes of one teaspoonful of sulphur upon live coals for fifteen minutes in the bleaching box. After bleaching, tray 5 was placed in the evaporator on ledge 9, while tray 6 was exposed to the sun in the open air near the ground at the south side of the insectary.

Lot B was spread upon trays 7 and 8. Tray 7 was placed in the evaporator on ledge 4, while tray 8 was exposed to the sun beside tray 6.

The temperatures of the bottom and top trays of the evaporator were taken at intervals of fifteen minutes as before, a maximum temperature of 96° to 98° C. being sought. For a few minutes at two different times the temperature of the bottom tray was above 100° C. After seven hours exposure to heat nearly one-half of the fruit was pronounced cured and was removed from the trays, the balance being taken out two hours later.

The gross and net weights of fresh fruit and the weight of cured fruit are shown in the following table:

Gross and net weights of fresh fruit and weight of cured fruit.

APPLES.

	Weight.		Cured in—		Total.
	Gross.	Net.	7 hours.	9 hours.	
Lot A (sulphured):	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tray 5	9.33	8.47	1.05	.77	1.82
Tray 6	9.33	8.80	.....	.....	1.74
Total cured fruit, lot A	.....	.....	.....	.....	3.56
Lot B (not sulphured):					
Tray 7	9.33	8.75	.46	1.43	1.89
Tray 8	9.33	8.83	.....	.....	1.79
Total cured fruit, lot B	.....	.....	.....	.....	3.68

Trays 6 and 8 were exposed daily to the sun in dry weather from 8 a. m. to 5 p. m., and were pronounced cured after about ten days of such exposure. A small portion of the fruit from these trays was destroyed by mice at night.

W. A. TAYLOR,
Acting Pomologist.

I have examined all these and found the scales all dead.

NATHAN BANKS.

EVAPORATION AND SUN DRYING OF PEACHES.

A basket of white-fleshed, freestone peaches, probably Fox (*Seedling*), infested with San Jose scale, was divided, by weight, into two equal lots, A and B. The fruit was cut into halves, and after removal of stones was spread upon trays.

As in the case of apples, lot A (spread upon trays 1 and 2) was exposed to the fumes of sulphur, while lot B (spread upon trays 3 and 4) was not. Trays 1 and 3 were placed in the evaporator upon ledges 1 and 7, respectively, with the apples, while trays 2 and 4 were dried in the sun, with the same exposure and for the same length of time as the apples. After seven hours of heat most of the fruit on tray 1 was pronounced cured, and at the end of ten hours all was removed from the evaporator.

The gross and net weights of fresh fruit and the weight of cured fruit are shown by the following table:

Gross and net weights of fresh fruits and weight of cured fruit.

PEACHES.

	Weight.		Cured in—		Total.
	Gross.	Net.*a*	7 hours.	10 hours.	
Lot A (sulphured):	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tray 1	6.89	6.26	1.25	0.04	1.29
Tray 2	6.89	6.28	.....	.....	1.25
Total cured fruit, lot A	.....	.....	.....	.....	2.54
Lot B (not sulphured):					
Tray 3	6.89	6.27	0.37	1.27	1.64
Tray 4	6.98	6.28	.....	.....	1.44
Total cured fruit, lot B	.....	.....	.....	.....	3.08

a After removal of stones and waste.

A lot of infested peach twigs and leaves were exposed to heat on top tray, the coolest portion of the evaporator, for five hours.

W. A. TAYLOR,
Acting Pomologist.

All the scales in this lot were dead.

NATHAN BANKS.

EXPERIMENT III.—EVAPORATION AND SUN DRYING OF VICAR PEARS AND BEN DAVIS AND BALDWIN APPLES.

On September 30 a basket of Vicar pears, badly infested with San Jose scale, was divided into two equal lots, A and B, by weight, as in Experiments I and II, and after being sliced into eighths, was spread upon trays. Lot A was spread on trays 2 and 3 and sulphured. Lot B was spread upon trays 4 and 9 and was not exposed to sulphur fumes. Trays III–A–2 and III–B–4 were placed in the evaporator. At the end of six hours most of the fruit was found cured and was removed, the balance being left until completion at the end of ten hours. The temperatures were practically identical with those of Experiment II. Trays III–A–3 and III–B–9 were placed in the sun for about eight hours each day on clear days, being exposed in this manner for about ten days, until sufficiently cured.

The gross and net weights of fresh fruit and weight of cured fruit are shown in the following table:

Gross and net weights of fresh fruit and weight of dried fruit.

VICAR PEARS.

	Weight.		After—		Total.
	Gross.	Net.	6 hours.	10 hours.	
Lot A (sulphured):	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tray III–A–2 evaporated	10.14	9.59	0.75	0.25	1
Tray III–A–3 sun dried			.....	.....	1.02
Lot B (not sulphured):					
Tray III–B–4 evaporated	10.14	9 27	0.63	0.20	0.83
Tray III–B–9 sun dried			.....	.....	1.03

On October 1, 1898, about one-half bushel of inferior Ben Davis and Baldwin apples was divided into lots as in the former experiments and tested in the same

way as the Vicar pears. The disposition and treatment of the trays is shown by the following table:

Gross and net weights of fresh fruit and weight of cured fruit.

BEN DAVIS AND BALDWIN APPLES.

	Weight.		After—		Total.
	Gross.	Net.	7 hours.	9 hours.	
Lot A:	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
Tray III–A–5, evaporated, not sulphured	12	9.35	0.79	.....	0.79
Tray III–A–6, evaporated, sulphured			0.75	0.43	1.18
Lot B:					
Tray III–B–7, sun dried, sulphured	12	10.25	.....	.....	0.96
Tray III–B–8, sun dried, not sulphured			.....	.....	1,09

W. A. TAYLOR,
Acting Pomologist.

All the scales in this fruit were found dead.

NATHAN BANKS.

A NEW COCCID ON BIRCH.

By H. G. HUBBARD and TH. PERGANDE.

PART I—By H. G. HUBBARD.

From my boyhood whenever I have visited the Lake Superior region my attention has been called to the general destruction of the bark of birch trees. It is difficult to find near the lake a tree of any size with smooth or natural bark, and I remember that in 1876, when Mr. Schwarz and I visited the north shore of the lake, at Michipicoten River, we were told that the Indians were obliged to go 60 miles back into the interior in order to find sheets of bark of sufficient size for the construction of canoes. During a visit to the south shore, not far from Marquette, in September, 1896, I discovered that this widespread destruction is due to the attacks of a coccid. The outer bark is roughened, covered with curls and splits, blackened with sooty mold and in bad cases entirely removed down to the last layer. Often the cambium itself is invaded and the tree is killed or seriously injured. Figure 1, *a* illustrates injury to a branch of birch caused by this insect.

The coccid introduces itself between the layers of the bark and by its growth and the formation of thick masses of wax along its flanks causes the bark to heave and the layers to separate in curls. On a smooth surface the first attack is made by the young larvæ crawling into the lenticels, or breathing pores of the bark, those little elongate corky spots which give to birch bark its elegant ornamentation. Afterwards successive generations of the insect force their way into the crevices thus formed and cause extensive separations between the layers. (See fig. 1, *b*). The female insect during its growing period is a memberless sac, as in the Diaspinæ. Its color is orange red and when compressed beneath layers of birch bark the form is flattened, broadly

rounded anteriorily, pointed behind and about the size of a grain of flaxseed. In young birch trees, the bark of which does not readily separate in layers, the insect infests knots, accidental wounds, or the vicinity of buds. In this case its form is not flattened but well-rounded and pyriform, and it occupies a deep pit sunk vertically into the cambium and even into the young wood. Occasionally in white birch, and also in aspen, similar pits are formed, whenever an accidental wound allows the insect to gain access to the succulent inner bark, in which alone, by some obscure absorptive process, the formation of such a pit is possible.

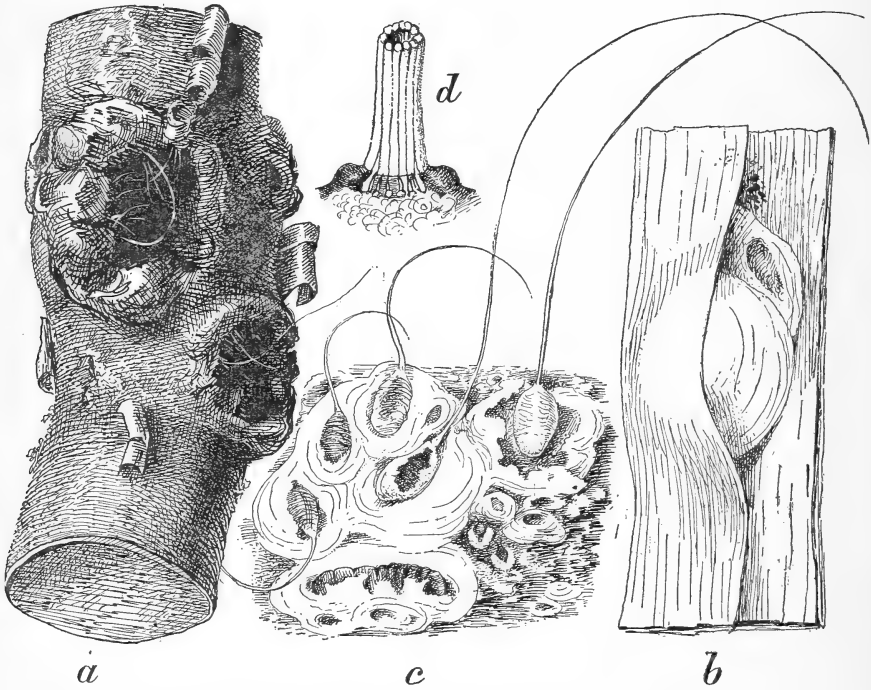

FIG. 1.—*Xylococcus betulæ: a*, branch of birch showing work; *b*, section of inner bark, showing cyst occupied by the coccid; *c*, coccids in position, with layer of bark removed, showing waxy secretion, surrounding them and rods of wax protruding from anal tube; *d*, section of rod of wax, showing its compound nature—*a*, natural size; *c*, enlarged; *b* and *d*, greatly enlarged (original).

Small curls of wax are given off from pores thickly scattered over the body of the coccid, but more copiously from the sides, where the excretion becomes consolidated into thick laminæ of white wax. The anal extremity produces numerous stronger waxen curls, and in the midst of these there issues, from the anus itself, a tubular bundle of waxen rods condensed into an apparently solid thread, which does not curl, but forces its way out of the nearest crevice in the bark into the open air. (See fig. 1, *c*, showing coccids in natural position on bark; and *d*, which shows section of waxy rod.) In fair weather these glassy hairs may be seen issuing from every crevice in the bedeviled cortex,

often reaching a length of one or two inches, and giving a hoary appearance to certain spots on the trunk. Clinging to every hair is a glittering drop of honey dew. The bundle of waxen bristles is in fact a contrivance admirably adapted to remove the copious flow of saccharine excrement which would otherwise condense about the insect and exclude communication with the outer air.

Mr. Pergande has made many slide mounts of the coccid, and his preparations, cleared with potash, show that the long anal thread is produced by an internal chitinous tube, formed by the union around the end of the anal canal of numerous spinnerets. These are the chitinous terminations or formative tubes of major wax glands, which open into the intestine in two encircling ranks, one above the other. The union of these spinneret tubes forms a rigid chitinous honey-dew organ, which is capable of a forward and back motion and can be protruded a considerable distance out of the body. When withdrawn, the opening is closed by several ranks of stout converging spines. This internal organ is in truth the ninth abdominal segment. The eight preceding segments of the abdomen are marked by a pair of spiracles on either side of each. The spiracles have large and simple openings, but within the body form trumpet-shaped tubes, in the constricted necks of which are seen large pores, the openings of lubricating wax glands. The existence of one or of two rings of these spiracular pores is the most marked distinction between the sac-like females before and after the second molt. There are no spiracles anterior to the abdominal portion of the body in the female, nor are any other organs visible upon the exterior save the elevation of the clypeus, with its single-jointed lower lip, or clasper, from which issue the mouth bristles. The internal framework of the buccal organs is large and similar in appearance to that seen in the Diaspinæ and the Lecaninæ. It does not appear to possess the sucking apparatus of the former group, and is probably as simple in structure as in the Lecaninæ. The eye spots seen under the skin in living specimens disappear in cleared specimens and have no external cornea. The sac-like females, when they have reached full size and have cast off their mouth bristles, undergo still another metamorphosis, in which they regain legs and antennæ, but lose all the organs of nutrition. The female in this ultimate stage has a well-segmented body, rounded behind and sparsely clothed with hairs. The antennæ are long and nine-jointed; the legs are large and strong and of the normal adult type. There is no trace of mouth parts or of anal tube. The adult is thus an ordinary monophlebid. It is capable of locomotion and does occasionally wander about. But ordinarily it is unable to leave its cell in the bark, and does not entirely free itself from the skin of the preceding stage, but merely ruptures the inclosing sac, shoves off the pygidial cap with its accumulations of wax, and presents the end of its body at the crevice in the bark for the reception of the male. After fecundation eggs are deposited and are collected beneath the body of

the mother in an external cavity formed by the collapse of the ventral skin into the depleted abdomen. The larva in hatching leaves behind both the eggshell and an embryonic pellicle (amnion?). As the parturient mother may be wholly inclosed within the inflated skin of the second stage, the young frequently appear to issue from this form of the female, and it is easy to understand that with scanty material and limited opportunity for observation the adult female might wholly escape discovery and the sac-like female of the second stage be pronounced a mature viviparous insect.

The newly-hatched larva is of a highly organized type. Its thoracic segments are distinct, and the form of the body resembles a young Cimex. The end of the abdomen is broadly rounded, without tubercles or long trailing hairs, but with the anal tube projecting slightly beyond the margin. The ventral surface of the abdomen shows a median row of five large pores.

The young in both sexes form their waxen cells in a similar manner; but the males never form pits, and are apt to assemble in the vicinity of some older female and establish themselves under the protection of her accumulations of wax. After the first molt the females lose their legs and antennæ and assume the sac-like form already described. The female undergoes four molts and has five stages, of which the larva and the adult are active and possess legs and antennæ. The three intermediate stages are stationary and differ from each other only in minute details of internal structure.

The male undergoes five molts and has six stages, in all of which, except in the third, it possesses legs and antennæ. After the casting of the first larval skin the young male lives and feeds like the female, surrounded by a wall of wax. In this form it possesses well-formed legs and antennæ and has external eyes. It produces honey dew and abundant wax, and forms a long waxen thread from a tubular anal spinneret. With the second molt the legs and antennæ disappear, and the insect resembles a female of the second stage.

With the casting of the apodous skin at the third molt the coccid regains both legs and antennæ, but loses its rostrum. In this fourth stage, which may be called the first nymph of the male, the animal leaves its waxen cyst and wanders about. It is red in color and resembles a young Dactylopius in general appearance. Little tesselations of cottony wax soon arise all over the body, which becomes covered with a loose flocculent follicle, in which the insect rests until ready for the fourth molt. It then breaks out of its covering and casts its skin under some sheltering fragments of bark. The new form which now appears, the fifth, is a true nymph, with wing pads and a polygonal protuberance at the end of the body inclosing the rudimentary genital organ. This second nymph, after wandering free for a time, in its turn covers itself with a cottony follicle, out of which it breaks again to cast the last skin and transform to the winged male. This last form

has been bred by Mr. Pergande and is a marvelously beautiful insect, with two large abdominal brushes which it spreads like the tail of a peacock. It has prominent faceted eyes, a long, slender penis, and four hooks on the rudimentary hind wing. Its structure is that of a male Cœlostoma. The transformations to the adult stage in both sexes probably take place in the spring and early summer. In the winter the only living forms to be found are in the encysted stages under the bark. The insect has at this time a disagreeable odor of rancid fat.

These remarkable transformations are not without parallel in the Coccidæ, although the full life history has never, to my knowledge, been worked out in any allied form. In Porphyrophora and Margarodes there is a similar retreat into an encysted stage, with reappearance of the organs of locomotion in the adult female when it breaks forth from its subterranean pearl. The transformations of the male in these genera have never been made known and the winged male is known in Porphyrophora only. In certain forms from New Zealand and Australia, for which Maskell erected the genus Cœlostoma, very similar changes occur in the female series, although I am not sure that in any of the described species a complete absence of all legs and antennæ has been noted. In *Cœlostoma zealandicum*, the type of the genus, described in Trans. N. Zealand Institute for 1879 (Vol. XII, p. 294), and also in the same Transactions for 1881 (p. 226) and 1883 (p. 141), Maskell describes the second stage of the female as having partially atrophied feet and antennæ; and in his Coccidæ of New Zealand (Plate XX) he figures a spiracle of the female with a constricted neck and ring of pores, and also an anal "honey-dew organ," which evidently has a similar construction to that seen in our coccid from birch. Again, in the New Zealand Transactions for 1889 (p. 153), Maskell describes and figures (Pl. IX, figs. 19–22) precisely similar internal organs in *Cœlostoma assimile*, and states that the female of the second stage is globular, with conical four-jointed antennæ and without feet. The insect in this stage is covered with a hard waxy test, and is found in the axils of twigs of Fagus. Finally, in 1882, F. Loew (Verhandl. d. k. k. Zool.-Bot. Ges., Band XXXII, Taf. XVI) describes and figures under the name *Xylococcus filiferus* a coccid which he found buried in pits in the axils of twigs or buds of linden at Baden, Austria. His figures indicate a form very closely allied and probably congeneric with the birch coccid of which we have been treating. But in his description Loew considers as the mature stage what is evidently one of the legless intermediate forms of the female, and details the issuing of the young from this form as from a viviparous adult. The manner in which this mistake may have been made and the true egg-producing female overlooked has been sufficiently indicated above. Loew moreover figures and describes as the second stage of the female a form having antennæ, but with legs represented by coxæ and trochanters, which corresponds in every respect to the encysted second larva of the

male from which the legs have been lost in mounting the specimen, a mutilation which our experience with the birch coccid shows is very likely to take place.

In view of the close coincidence in such details as are given by Loew between *Xylococcus filiferus* and the coccid described in these pages I have no doubt whatever that the same transformations will be found to occur in both, and that our coccid of the birch is a species of Xylococcus. The remarkable tubular ninth segment, which in Cœlostoma Maskell calls a honey-dew organ, is a character which will probably unite those coccids which are found to possess it in the same subfamily and indicates an approach to the Lecaninæ, in which the ninth segment is also internal and similarly modified. In the Lecaninæ, however, the penultimate segment is also modified and transformed into the two anal valves, and the eighth abdominal segment terminates the body behind. Many interesting suggestions arise as to the affinities between these coccids and the lac insects (Carteria, etc.), which approach yet more closely to the Lecanid type, and on the other hand as to their relationship with the Monophlebids, which are supposed to have no modified anal segment and the ninth segment terminal in all stages.

It is apparent, however, that in Xylococcus and Cœlostoma we have to do with a subfamily of Coccidæ not hitherto recognized, and to which no doubt will be added other genera at present included in the heterogeneous division Brachyscelidæ and also in the Monophlebinæ. Our knowledge of the metamorphoses in these exotic insects is in almost every case quite incomplete. In many the intermediate stages remain unknown.

Since the foregoing pages were written Mr. Pergande has continued the observations which we began in common, and, with the acuteness of research which characterizes him, has discovered an additional stage in each sex, the most noteworthy being the legless third stage in the male series. Through his courtesy I have been enabled to correct my preliminary notice to correspond with his detailed descriptive paper which follows.

PART II.—By TH. PERGANDE.

(*Xylococcus betulæ* Perg.)

After Mr. Hubbard and I had, as we supposed, concluded our observations upon the transformations of this very remarkable coccid, I was enabled, by further study of the living material at hand, to recognize an additional stage in each of the two sexes, raising those of the female to five and those of the male to six stages.

In our preliminary studies some apparently slight differences had been observed in what we considered to be the second and third stages, but we supposed them to be simply due to a greater or less development of individual specimens of the female series.

Remarkable as the changes of the female are, those of the male are still more wonderful. Up to a short time ago I had been of the opinion

that the male during its successive transformations retained both its antennæ and legs, but while happening one day to explore, in search of the mature male, a jar containing two sections of branches of birch, I discovered two living male larvæ, one of them in the act of casting its skin, and found to my surprise, after the insect had been extracted, that the cast skin showed all the characters of a young female in the second stage, in which there are neither antennæ nor legs; whereas in the form which had emerged from it these organs were highly developed. The rostrum, however, had been lost. This organ in the female is present in all stages except the last.

After examining and comparing the abundant material at hand of both sexes, I have arrived at the conclusion that this small and apodous form of the male is the third stage, differing from the second stage of the female in its somewhat larger size, the darker brown color of the posterior half of the body, and in minor characters.

I append herewith a description of the different stages of the two sexes, including the egg.

Xylococcus betulæ n. sp.

Egg.—Length 0.6^{mm} by 0.3^{mm} in diameter; regularly oval, highly polished, and of a pale yellow color.

First larva, after hatching.—Length about 0.5^{mm} by 0.3^{mm} across the broadest part of the abdomen. Color orange-red, the eyes purplish. Shape cimiciform, the abdomen very broad and semicircular behind. The thoracic and three or four anterior segments of the abdomen are highly developed, whereas the remaining segments of the abdomen form apparently a single piece. The anal or excretory tube is large, chitinous, and partly projecting. Antennæ six-jointed, very short and rather stout; joints one and six are somewhat the longest and subequal in length; the intermediate joints are shorter and also subequal in length, or the second slightly longer. The first is stoutest; all the others diminish gradually in diameter; the last is bluntly rounded at the apex. At the base of joint five externally will be noticed one long and stout, blunt and curved, spine. There are two similar spines at the base of the last joint, with four or more slender capitate hairs and one or two small spines at its apex, two or three of these hairs being at least as long as the antennæ. Eyes large and placed close to the antennæ. Legs long and stout; the tarsi longer than the tibiæ; digitules capitate, those of the claw somewhat the longest, stoutest, and curved upwards. Rostrum large, the sucking bristles extremely long. Each abdominal segment is provided with a large and projecting spiracle and a pair of backward-directed spines each side, which grow gradually longer toward the end of the body; in addition, a number of stout spines surround the anal tube. There is also a rather long bristle each side of the seventh segment. (See fig. 2, *a*.)

When the larvæ are about to cast their first skin they measure nearly

0.9mm in length by 0.6mm in diameter, those of the male being slightly smaller. Their shape has also considerably changed; they are now of a regularly oval form, and are stoutest anteriorly.

The cast skins (fig. 2, *d*) are pale yellowish, with the last three segments yellowish-brown and the anal tube dark brown. They present the following characters:

The rostrum is very large, distinctly two-jointed, and situated at about the middle of the body. The orifices of the stigmata are very large and circular, their internal prolongation about twice the length of their diameter, with the external half cylindrical constricted at the inner end, while that part beyond the constriction is obconic or funnel-shaped and connected with tracheæ, running parallel with the sides of the body. On the under side of the abdomen and in front of the anal tube may be observed a median row of five large pores, and similar pores, together with numerous smaller ones, on the upper side of the

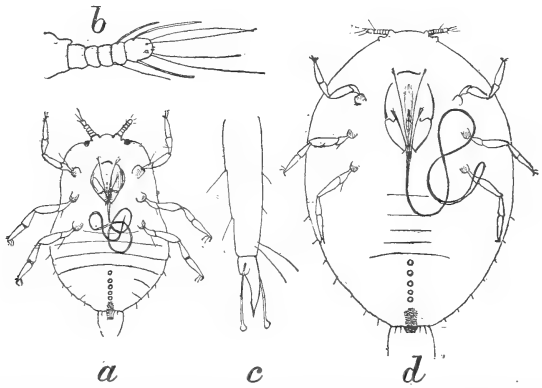

FIG. 2.—*Xylococcus betulæ*: *a*, first larva, male, female, ventral view; *b*, antenna; *c*, tarsus; *d*, cast skin of first larva—*a* and *d* much enlarged, *b* and *c*, more enlarged (original).

two last segments and along the sides of the abdomen; there are also numerous rows of minute sharp points on the dorsum of the six anterior segments of the abdomen, and in addition a row of sparsely set short and backward-directed spines, all of which arise from small tubercles. The cephalic and thoracic segments appear to be smooth and without pores. There seems to be no appreciable difference between the sexes, except that the male larvæ are slightly smaller.

In fig. 3, *a* and *b* respectively, are shown enlarged ventral and dorsal views of the end of the body of the female. At *c*, a stigma is figured highly magnified.

Female, second stage (*fig. 6, a*).—In this, as well as in all the following stages, except the last, the legs and antennæ are completely lost. All these stages are of an orange color, with the end of the body of a lighter or darker brown; the eyes are minute and blackish; their bodies are ovoid, somewhat broadest anteriorly, quite flat or slightly convex, smooth and shining, and without any apparent segmentation. The

fully grown larvæ of the second stage measure about 1.5mm in length by 0.9mm in diameter.

The cast skin is almost colorless, except the last three or four segments of the abdomen, which are pale yellowish-brown, the anal tube being darkest. The surface of the body is densely and finely granulated, the granulation being somewhat coarsest around the tube. See fig. 4. There are also small pores scattered over the body, intermixed with a few larger ones on the last four segments, which bear also a few backward-directed spines. The internal stigmatal tubes are now three times the length of those in the first stage; the outer two-thirds or more is cylindrical and finely and densely annulated; the inner end of the tube is bell-shaped, and in the constriction or neck of the tube may be observed a transverse row of large pores; the stigmatal tube is connected with the tracheæ by a rather long, annulated and bifurcate duct, of which one branch is longer than the other.

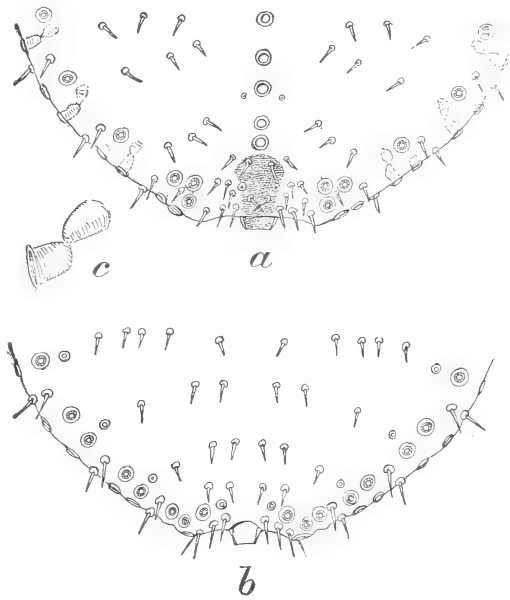

FIG. 3.—*Xylococcus betulæ*: *a*, ventral view of end of body of female; *b*, dorsal view of same; *c*, stigma, all much enlarged (original).

Female, third stage (*fig. 6, b*).—The mature larva of this form measures about 0.2mm in length by 1.4mm in diameter, and is very similar in appearance to the previous stage.

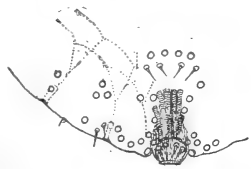

FIG. 4.—*Xylococcus betulæ*: dorsal view of end of body of second stage—much enlarged (original).

The cast skin is also colorless, except the two last segments, which are pale brownish-yellow. The pores are of two sizes and very numerous on the abdomen and also around the margins of the cephalic and thoracic segments. The surface appears to be smooth and without granulations, except on the last two segments, which bear also a number of stout spines each side of the anal tube. (*See fig. 5.*) The stigmatal tubes are similar to those in the previous stage, except that they are longer, and there are now two rows of pores in the constriction or neck.

Female, fourth stage (*fig. 6, c*).—Length 4mm to 5mm by about 2mm in diameter anteriorly. In the cast skin of this final larva the surface is again densely and distinctly granulated, especially so on the last three segments, which are now of a rather dark brownish-yellow color. The pores have become still more numerous and are arranged in irregular

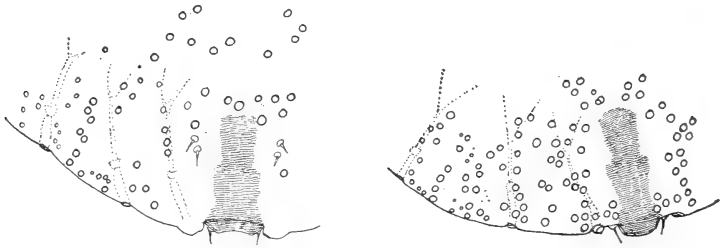

FIG. 5.—*Xylococcus betulæ*: *a*. Ventral view of end of body of third stage at left. *b*. Dorsal view of end of body of fourth stage at right—both much enlarged (original).

bands across the abdominal segments, becoming most dense and more irregular on the three last segments; some of the pores around the margin and end of the body are of complex structure; a pair of large pores being surrounded by a ring composed of numerous minute pores.

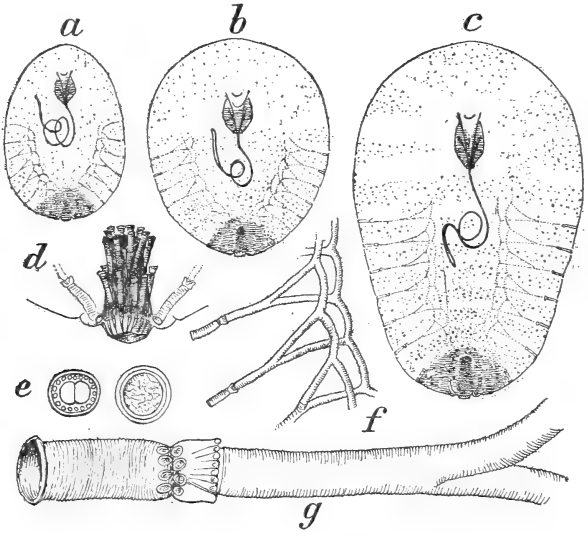

FIG. 6.—*Xylococcus betulæ*: *a*, female, second stage; *b*, female, third stage; *c*, female, fourth stage; *d*, anal tube showing internal structure; *e*, compound and simple pores of end of body; *f*, stigmatal tubes and tracheæ; *g*, bit of same more enlarged—*a*, *b*, *c*, greatly enlarged; *d*, *f*, more enlarged; *e*, *g*, still more enlarged (original).

Similar compound pores were also observed in the second and third stage. The stigmatal tubes are now about one-third longer than in the third stage, while in the constriction there are from two to three rows of pores. There now appears, placed medio-ventrally in the region

between the fourth and fifth pairs of stigmata, a brownish organ, probably the anus, represented by two backward-directed pointed prongs, with an oval opening in front of them.

Adult female (*fig. 7*).—Length 4mm by 2mm in diameter; color, when living, bright orange; eyes minute and purplish-brown. The body is elongated, elliptical, with both ends rounded; under side of the abdomen concave, its lateral margins revolute; the dorsum convex. All the segments are well defined. The anal opening is simple, situated on the under side of the abdomen, close to the concavity, and with difficulty to be seen. The rostrum is wanting. Legs stout and rather short; tarsi shorter than tibiæ; the digitules simple. Antennæ stout and nine-jointed; the first joint is the longest and much the stoutest, being nearly twice the diameter of the second joint; joint two is slightly longer than the last one and cylindrical; joints three to eight are subequal in length, of nearly the same diameter and somewhat stoutest near the apex, where they bear a fringe of fine hairs, which grows gradually longer toward the end of the antennæ; the last joint is rounded at the apex and bears three or four fine hairs and the same number of slender spines. The body is covered with short and stiff brownish hairs, which are stoutest and most dense at the end of the abdomen. The pores are small and scattered. The stigmatal tubes are simsimilar to those in the previous stages. (See figs. 7, *a*, adult female and *b* antenna of same.)

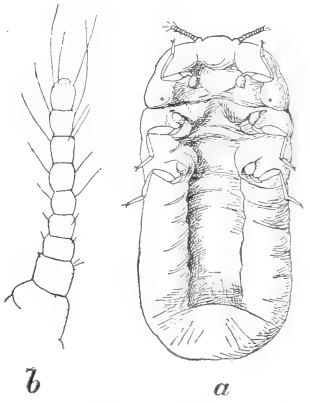

FIG. 7.—*Xylococcus betulæ*: *a*, adult female, seen from below, much enlarged; *b*, antenna of same more enlarged (original).

Male.—The young larvæ of this sex resemble those of the female in every respect, except that they are a little smaller.

Male, second stage.—Length about 1.9mm by about 1mm across the thorax. Color quite dark orange. The thorax, as well as the abdomen, is distinctly segmented; sides of the abdomen parallel, broadly rounded behind; head and thorax combined about one-third longer than the abdomen, the mesothorax being the largest. Antennæ seven-jointed, short, stout, and moderately tapering; first joint longest and stoutest, the second joint shortest; three to six subequal in length and somewhat longer than the second, the seventh about as long as the two preceding united, and bluntly rounded at tip; all bear long and fine hairs about the apex, and the seventh, in addition, a number of stout spines. Legs long and stout, the tarsi shorter than the tibiæ, the digitules fine and hair-like. There appear to be numerous hairs scattered over the body, most dense around the end of the abdomen.

Male, third stage.—In changing to this form the larva loses both the

legs and antennæ and assumes the apodous type of the female in its second stage, differing, however, from the latter more particularly in its more elongate form and in the much darker brown color of the end of the body, which coloration here extends over the last six segments. It measures now about 2mm in length by 0.8mm in diameter at the anterior end. The last six segments in the cast skin are yellowish-brown, becoming darker toward the end, and all are densely covered with small sharp points. Pores and stigmatal tubes similar to those of the female in the second stage.

Male, fourth stage.—This stage, upon casting its apodous skin, which act I fortunately observed, regains its legs and antennæ, but loses its rostrum. Its length is 2.6mm by 1mm in diameter. Color orange, with legs and antennæ somewhat paler. Eyes dark purplish, rather large, and placed close to the antennæ on the under side of the head. Shape elliptical, rounded at both ends. All the segments are well developed, and the combined head and thorax is longer than the abdomen. The mesothorax now shows traces of the future wingpads. In the recently emerged larva of this stage the front of the head is simply convex, but becomes more or less prominently conical with advancing age. The legs are rather long and stout, with the digitules fine and hair-like. The whole body is sparsely covered with brownish hairs, which grow more numerous and longer around the end of the body. Antennæ nine-jointed, although in the recently emerged larva the division between the second and third joint is not strongly marked. Joint one is stoutest; all the others diminish gradually in diameter. The three basal joints are longest, and nearly subequal in length; the following five joints are shortest, subequal in length, and somewhat stouter at the apex. The last joint is somewhat longer than the eighth, cylindrical, and rounded at the apex. All bear a few fine hairs, which grow gradually longer toward the end; the last joint bears also a few short spines at the apex.

Male, pupa, or fifth stage.—The cast skin only has thus far been observed. It measured about 1.4mm in length. Its color is orange, with antennæ and legs dusky; the antennæ annulated with white. Antennæ nine-jointed, very long and stout, cylindrical and of equal diameter, reaching to the abdomen; joint one is slightly stouter than the rest, but all are subequal in length; the last is bluntly rounded at the apex; all are destitute of hairs or spines. Wing-pads very broad, reaching beyond hind coxæ. Legs very long and stout; the tarsi about one-third the length of the tibia, and apparently without a claw.

Male, imago (*fig. 8*).—Length about 2mm; length of wings 2.4mm by 0.8mm broad; expanse 5mm. General color red, with the under side of the abdomen brown; the two basal joints of the antennæ reddisn, and the last three or four joints yellow, the intermediate joints black. Eyes, legs, mesothorax above, the mesosternal and metasternal plate, a curved line each side of the prothorax, as also two converging lines in

front of it, and a median line on under side, the borders of the scutellum and median line of the abdomen all black; median line of the head and eight transverse bands on dorsum of abdomen dusky. Wings cinereous, the costal space fuliginous, the veins blackish; a streak near the discoidal vein in front and a narrow oblique streak behind the vein colorless. There appears to be several branches to the discoidal vein, which however gradually disappear in the mounted specimens. Surface of the wings irregularly reticulated. Posterior wings present, though small, and broadly §-shaped, bearing four stout hooks at the apex.

Antennæ ten-jointed, reaching to the middle of the abdomen. Joint three is longest and somewhat stouter at the apex; the joints following

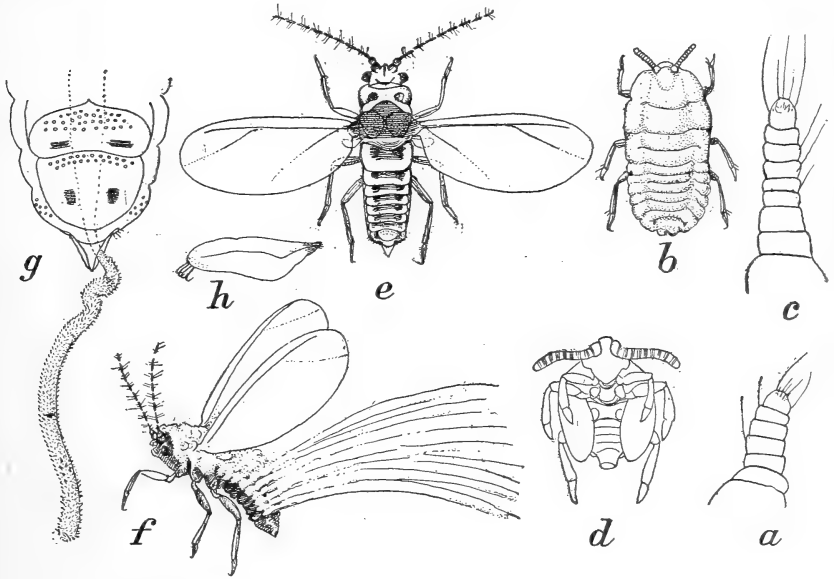

FIG. 8.—*Xylococcus betulæ*: *a*, antenna of male, second stage; *b*, male larva, fourth stage; *c*, antenna of male, fourth stage; *d*, pupa skin; *e*, male imago, dorsal view; *f*, male, side view; *g*, end of body of male, with sexual organ; *h*, hind-wing of male—all much enlarged (original).

are cylindrical and diminish gradually in length; the first joint is stoutest and shortest, the second joint somewhat longer; all are provided with rather long and fine, irregularly arranged hairs. Eyes large, projecting, and quite coarsely facetted. Legs long and quite stout; the tibiæ hairy; tarsi two-jointed, the first joint minute, though distinct; digitules extremely fine. Style short, stout, conical. The sexual organ is at least as long as the abdomen, stout, and densely covered with forward-directed, lanceolate scales. The insect is covered above with a short and wool-like excretion, while the sixth and seventh abdominal segments bear each a dense, transverse, dorsal brush of delicate, white, and hair-like threads, exceeding the abdomen

in length. These brushes are raised and spread out when the insect is touched. (Fig. 8.)

In studying this remarkable insect and comparing its characters with those of the various subfamilies hitherto described, I have been greatly puzzled to refer it to its proper position. On the one hand, it is closely related to the genus Cœlostoma, though very different in all its characters from other Monophlebinæ, at least as far as the genera Monophlebus and Icerya are concerned, while on the other hand there appears to be also a relationship with certain genera of the Brachyscelinæ, and at the same time a wide divergence from the genus Brachyscelis itself, the characters of which, as represented in *Brachyscelis conica*, I have had the opportunity to examine in a female. These considerations place it undoubtedly in the Acanthococcidæ, somewhere near the genus Eriococcus. These acanthococcid characters of *Brachyscelis conica* are the large and distinct anal ring, surrounded by numerous long and stout bristles, and the abnormally elongated and slender anal tubercles.

Since the characters of the two known species of Xylococcus and those of the species of Cœlostoma are unique and unlike those of all other subfamilies of Coccidæ, as far as known to me, I propose to erect for the accommodation of these two genera the subfamily Xylococcinæ, which properly may be placed between the Monophlebinæ and the Acanthococcinæ. They differ from the Monophlebinæ in the absence of legs and antennæ in the intermediate stages of the female and partly so in the male; the absence of a rostrum in the mature female; the highly developed stigmata of the abdominal segments; the strongly chitinous character of several of the terminal segments of the abdomen, and the presence of a highly organized and chitinous anal tube, which is capable of being projected out of and of being withdrawn into the body.

In the true Monophlebinæ the legs and antennæ, as well as the rostrum, are present in all stages; the abdominal stigmata are wanting or not observable; the end of the body is not chitinous; the anal opening simple and the anal tube absent.

From the Coccinæ they differ not only in the characters mentioned above, but also by the absence of anal tubercles, except minute ones in the young larvæ, and the absence of a true anal ring with its accompanying bristles.

THE PEACH LECANIUM.

(*Lecanium nigrofasciatum* n. sp.)

By Theo. Pergande.

Lecanium persicæ Mod.—Murtfeldt, Bull. 32, Div. of Ent. U. S. Dept. Agr. 1894, p. 41.

Lecanium persicæ Mod.—Howard, Yearbook U. S. Dept. Agr. 1894 (1895), p. 270.

This handsome little species has been known to the writer since 1872, when it was discovered upon peach trees at Hillsboro, Mo., and since

then increased steadily and has been spreading gradually over the peach orchards of the Middle, Southern, and Eastern States and appears to be at present most abundant and most widely distributed in the State of Maryland. Whether its original home was the East or West is difficult to ascertain, though its greater abundance in the tier of States bordering the Atlantic seems to indicate that its original home was in the region south of New York and north of the Potomac River and that from this region it had been distributed with cuttings and young trees, and to a lesser degree through the agency of birds and insects, over all the infested regions.

Until recently this scale has been considered a specific enemy of the peach, but while studying it in connection with the large amount of material of various species of Lecanium infesting our fruit trees as well as those of our forest trees and shrubs, which had accumulated during the last twenty years in the collection of the Department of Agriculture, I was struck by the great similiarity of certain small scales, differing from each other and from the peach scale but slightly in size and general appearance, and found, after preparations and examinations of scales from various plants and localities, that all of them belong to the same species and that the slight and superficial differences appear to be due to the difference in the food plant on which they were living and to a greater or less extent also to the age of the specimens when found.

Fig. 9.—*Lecanium nigrofasciatum:* adult female—enlarged (original).

Food-plants: Most frequently, besides on the peach, they were found on various kinds of plum. They were found on cultivated plums at Kirkwood, Mo.; Chambersburg, Pa.; Newark, Del.; Harmons, Md., and Knoxville, Tenn.; on a native plum at Ruma, Ill.; on damson plum at Baltimore, Md.; *Prunus simonii* at Waynesboro, Pa.; and on wild goose plum at Augusta, Ga. They were also equally common on *Acer saccharinum* at Boston, Springfield, Holyoke, and Deerfield, Mass.; at Poughkeepsie and Ithaca, N. Y.; Paterson, N. J.; Richmond, Ohio, and western Ontario, Canada. At Reading, Mass., on Acer *pseudoplatanus*, and at Pine City, Ga., on *Acer rubrum-drummondi;* at St. Louis, Mo., on apple, and at Washington, D. C., on Cratægus; on sycamore at Kirkwood, Mo.; on Bumelia and *Lindera benzoin* at Washington, D. C.; on olive at Crescent City, Fla.; and on Vaccinium at Manatee, Fla.

Considering the various trees and shrubs on which this species has been found, the indications seem to point strongly to our native plums as original food plants.

Living specimens, when being crushed, emit a disagreeable odor.

As late as 1895 this species has been considered as being identical with the European *Lecanium persicæ* Modeer, but in order to settle this important point definitely, specimens of it were transmitted through

the Division of Entomology of the Department of Agriculture to the eminent and well-known English Coccidologist, Mr. J. W. Douglas, of London, England, for his opinion. He kindly examined them and pronounced them to be very different from *persicæ* and to form an undescribed species.

The life history of this scale has to some extent been studied by Miss Mary Murtfeldt, of Kirkwood, Mo., and is herewith reproduced from Bull. No. 32, Div. of Entom. U. S. Dept. of Agr., 1894 (pages 42 and 43).

On May 2, my attention was called by a friend to a young Lombard plum in his garden, which exhibited the worst case of attack yet seen—probably the unchecked development of several seasons. The twigs and smaller branches were absolutely incrusted on all sides with the Coccids, presenting to other than entomological eyes, a repulsive spectacle. Even at this late date segregation had not taken place. By the 20th of the month, however, the eggs were fully formed and every scale was crowded with them. The egg is broad, oblong in form, 0.5mm in length, pale yellow in color, and in the mass quite free and granular. Hatching began June 10 and continued for nearly a month. The young larvæ were the largest species yet observed, very flat, uniformly pale yellow, the carapace being indicated by a very thin lateral rim. The legs were rather long and well developed. Antennæ five or six jointed, one-half the length of the body. By July 15 hatching was completed, and in the meantime, those first hatched, of which a part were separated and kept on fresh twigs in the rearing jar, had nearly all become stationary on the leaves and transformed to male pupæ. Twigs brought me from the tree at this date had the foliage covered with the young in all stages, the majority being still in a state of great activity, resembling in general appearance and in the peculiar wavy motion when crawling a myriad of small Tingitids. The sexes were undistinguishable. The mature larval scale is about 2mm in length, slightly convex, of a translucent greenish-white color. Two converging carinæ inclose a narrow flat dorsal space, from which a border, divided into six or seven panes, by similar, though finer, opaque, white ridges, slopes slightly on all sides. Under the scales, which were stationary, and which in no respect differed from those that were still moving about over leaves and twigs, were found male pupæ entirely detached and displaying wing pads and other members as seen in nymphæ of the higher Hemiptera.

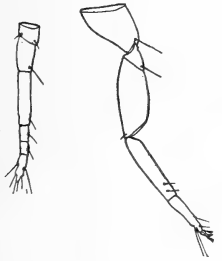

Fig. 10.—*Lecanium nigrofasciatum:* antenna at left; leg at right—much enlarged (original).

On the 22d of July winged males appeared in the rearing jar, the pupal period being about one week. In this stage, also, the insect is beautiful, with filmy, iridescent wings expanding 4mm; body rose red, with some dark brown shadings about the head and tip of the abdomen, and an especially distinct, dark-brown, transverse thoracic band. August 10 hundreds of winged males, fresh pupæ, and active larvæ were still found on the leaves. The act of copulation did not come under my eye, although the winged forms continually fluttered over those that were crawling. The life of the male seems to be of about a week's duration. My observations on this insect were interrupted by absence from home from the middle of the month until the 5th of September, when I found that the males had disappeared and that the females had attached themselves to the bark of such twigs as still retained a measure of vigor. The scales were about one-half grown, had darkened, thickened, and become centrally elevated. As in all scales, growth by the exudation of waxy material around the margin was slowly progressing. At the

present date (November 10) the scales are not more than two-thirds the size that they were last year, and not nearly so numerous, and drop easily from the twigs upon which the black fungus has appeared. This is very likely due to the debility of the tree, which will scarcely survive the winter.

DESCRIPTION OF ADULT FEMALE.

The adult female (fig. 9) is from 3mm to 4mm long by 2.6mm in diameter, and about 2mm high. It is slightly broadest posteriorly, hemispherical, highly polished, and if not rubbed is seen to be covered with a very delicate, transparent, and glossy or waxy excretion. There are apparently twelve more or less distinct and radiating ridges each side, which are most noticeable around the margin of the body and starting at some distance from the disk of the scale, those of the thoracic segments being generally more highly developed. The disk or medio-dorsal stripe is smooth or but faintly rugose. The general color is of a lighter or darker red, with a broader or narrower blackish subdorsal band surrounding the disk composed of confluent spots, and a marginal row of elongated squarish spots or bands between the ridges of the same dark color, which frequently extend to the subdorsal band, which give to them a peculiarly pretty appearance. Frequently they may be entirely black, with the exception of the median stripe, or they may be entirely red, with but faint traces of darker shadings or markings, while in dry specimens all the markings disappear entirely.

After boiling them in potash they become almost colorless or of a pale brownish yellow, while the fluid turns to a pale purplish color. The anal plates and a broad margin around the anal opening are darker and of a yellowish-brown.

Owing to the extreme transparency of the derm after boiling, the pores become invisible, except a medio-dorsal row of irregularly arranged pores, reaching from near the end of the body to or beyond the region of the median pair of legs. The marginal spines are rather small and sparsely set, with three longer ones, of which the median one is much the longest in the lateral angles of the thorax. The antennæ (see fig. 10) are six-jointed and about 0.20 of a millimeter in length, the third joint being much the longest and about as long as the last three joints combined; the second follows next in length, then the sixth and first, while the fourth and fifth are shortest, subequal in length, and together somewhat shorter than the sixth. All bear the usual complement of hairs. The legs (see fig. 10) are rather long and slender and about 0.32 of a millimeter in length and provided with the usual hairs or bristles. The digitules of the tarsi are slender, finely knobbed, and about three-fourths the length of the tarsi; those of the claw are much shorter, curved upward, enlarged toward the end, and but slightly longer than the claw.

There is generally more or less variation in the length of both the antennæ and legs of specimens taken from the same twig, and even in the same individual; sometimes, though rarely, there appears to be a faint trace of a division of the third antennal joint.

THE WORK AGAINST ICERYA PURCHASI IN PORTUGAL, WITH AN ACCOUNT OF THE INTRODUCTION FROM AMERICA OF NOVIUS CARDINALIS.

By L. O. Howard.

In several of the previous bulletins of this Division mention has been made of the occurrence of the white or fluted scale (*Icerya purchasi*) in disastrous numbers in the orange and lemon groves along the banks of the river Tagus in Portugal. This insect, which reached Portugal some years ago probably from her colonies in the Azores, to which point it was probably introduced many years previously from Australia upon acacias grown as wind-breaks for the orange plantations, has attracted the attention of the Portuguese Government by its damage during the last two years. Senhor Alfredo Carlos Le Cocq, of the department of agriculture of Portugal, has published a number of communications upon this insect in the "Archivo Rural, Gazeta Dos Lavradores," and in the numbers of this journal for December 28, 1897, and June 28, 1898, gives excellent summaries of the spread of the insect, the work which has been done against it, and especially of the results of the attempts which have been made through the U. S. Department of Agriculture, aided by the State Board of Horticulture of California, to introduce and acclimatize the Australian predatory enemies of the scale. In the article first mentioned is given an account of the spread of the scale in the district of Lisbon. In and about the city of Lisbon nearly all of the private and public gardens and nurseries are infested and the insect is found in thirty-two other localities. Prior to the attempt to introduce natural enemies of the insect extensive experiments with washes were carried on under the direction of the Chemical-Agricultural Station of Lisbon. After much experimentation it was determined that an emulsion of bisulphide of carbon with soapsuds was the most rapid and effective of all. The formula used is as follows:

Black potash soap	kilograms..	1.5
Warm water	liters..	10
Bisulphide of carbon	do..	3 to 4
Cold water	do.....	90

The soap is dissolved in the warm water and when the solution cools the bisulphide is gradually added, agitating it constantly to make the emulsion homogeneous, the latter being finally diluted with the cold water, care being taken to stir well before using.

It is reported that there is no inconvenience in preparing sufficient quantities for one or two days' use, but it appears that the emulsion prepared the evening before using is more energetic, from which we judge that there is a gradual evaporation of the bisulphide from the emulsion. There is some danger of the pump rusting as the result of the action of the bisulphide, and it should be washed out with water several times after use and wiped dry. Moreover, only vulcanized rub-

ber should be used for the hose, since the ordinary rubber hose is attacked by the bisulphide. The Vermorel pulverisateur can not be used for the reason that bisulphide attacks the composition of the diaphragm and the small leather valves. This mixture has also been found effective against other scales. The passage of a law is urged which shall enable the administration to take prompt measures in a case of insect outbreak.

The writer's first knowledge of this outbreak was in September, 1896, when he received a letter from Senhor Armando da Silva, accompanied by a copy of an article which he had published in the Correio da Noite of September 10. Senhor da Silva wrote to ask for advice as to the most efficacious means of fighting the insect in America and for references to the literature on the life history of the insect and its allies. We replied under date of October 1, 1896, urging him to make an effort to introduce *Novius* (*Vedalia*) *cardinalis*. In February, 1897, Senhor da Silva sent specimens of the Icerya, which we were able to determine as undoubtedly *I. purchasi*, and we addressed him again on the subject of the importation of *Novius cardinalis*, offering to secure specimens for Portugal through the State Board of Horticulture of California. While awaiting his reply we received a communication from Senhor Le Cocq, with whom Senhor da Silva had been in communication and with whom our subsequent correspondence was carried on. In the meantime Senhor da Silva had published in the last number of the volume for 1896 of the "Annaes de Sciencias Naturaeas" an extended article in which he gave an account of the work of *Novius cardinalis* in this country and urged its introduction. Curiously enough this publication, as we have recently learned from an editorial in "O Jornal de Lisboa" for September 7, 1898, was considered by many prominent persons as based upon untrustworthy evidence and American brag [*reclame*], and it even seems that there were a few who insinuated in an agricultural review that the whole article was simply an interested petition for a commission to be sent to Australia! Undaunted, however, by this home opposition, Senhor Le Cocq took up his correspondence with this office, and in October, 1897, the writer was able to secure, through the great kindness of the State Board of Horticulture of California, about sixty specimens of *Novius cardinalis*, in the adult condition, and some larvæ, as well as a number of specimens of *Novius koebelei*. These were sent by direct mail from Washington, packed in moss, with a plentiful supply of Iceryas as food, just as they had been received from Mr. Alexander Craw, of San Francisco. But five of the Vedalias reached Portugal alive. These issued from the moss as adults and had quite certainly come from the specimens which left America in the larval condition. All of those which started from here as adults were dead. They were at once placed in glass jars at the Chemical-Agricultural Experiment Station at Lisbon, and were so successfully cared for that at the date when Senhor Le Cocq wrote his December

article there was already a numerous progeny. All of the specimens of *Novius koebelei* were dead on receipt.

On the 22d of November a second colony of the two species of predatory beetles was received from California. Inasmuch as the mail packet before had gone in a somewhat roundabout way, an attempt was made this time to hasten the journey. The writer took the packet personally to New York and placed it on cold storage awaiting the arrival of the direct steamer to Lisbon. Unfortunately the arrival of the steamer in New York was very considerably delayed, and upon its arrival in Lisbon it left for Porto immediately after the disembarkation of its passengers, and only on its return to Lisbon, December 19, was the packet containing the insects delivered to Senhor Le Cocq. The packet had left California on the 5th of November, so that it had been forty-four days on the journey. There were still alive, however, one male and five females of *N. cardinalis*, and owing to the great care which was taken of them they survived and multiplied. All specimens of *N. koebelei*, as before, were dead, from which it seems that the former resists these long voyages in hermetically sealed boxes better than the latter.

As to the further results of the experiment we can do no better than to quote the words of Senhor Le Cocq in the "Archivo Rural" of June 28. The article has been translated from the Portuguese by Mr. Frank Benton, of this office.

In No. 24 of the "Archivo Rural," published in December, 1897, we told our readers what we had done to introduce into Portugal *Vedalia cardinalis*, which is the most voracious enemy of *Icerya purchasi*, and what we had obtained and hoped to obtain up to spring in order then to commence its reproduction and breeding in the open air. Now we see that we were then very modest in our calculation, because four months later, in place of hundreds of Vedalias that we counted on having, we possessed already many thousands of the insects, and we were able to think of entering simultaneously upon its breeding on a large scale in the open air and its distribution in the localities invaded by Icerya.

In order that our readers may form an idea as to the fecundity of *Vedalia cardinalis*, it will suffice to state that our entire breedings were all descendants of the six insects received on the 19th of December—that is, from the second sending that Mr. L. O. Howard made me.

During this new apprenticeship we had occasion to try various modes of breeding the Vedalias in glass jars, and that which gave us the best result—the only one which we still follow to-day and that has also been adopted in the chemical-agricultural station of Lisbon, is the following: Small tables (tablets) of pasteboard are made, which, flat side up, pass into glass jars, leaving some space around them, the jars being cylindrical and tall; to each of the tablets there are glued four legs made of the same material, 2 to 3 cm. high and triangular. To give sufficient firmness to these legs each one is folded from the top to the middle of the base in the form of a piece of guttering, and is glued by the base to the lower side of the tablet near the corners, with the vertex down. On these tablets, which are flat, there is glued an octave-shaped piece of paper whose edges, extending the breadth and length of the cardboard, are folded up so as to form sides around the tablets.

It is on these small tables that, once or twice a week, a fresh repast of Iceryas is furnished to the Vedalias contained in each jar, the new tablets being placed above

those already in position. The various tablets placed successively remain thus, forming within the jar a kind of series of shelves, or an *étagère* on whose shelves the successive generations of Vedalias go on reproducing, feeding, and distributing themselves.

The Iceryas left from the earlier feedings are not removed from the jars, in order not to lose the eggs that the Vedalias place under the oviferous sacs of the former, nor the small larvæ that have already hatched there, or which are found in search of Icerya eggs among the sacs mentioned above.

Two or three tablets with fresh Iceryas may be inserted each time according to the number of Vedalias which exist in each jar and the larger or smaller number of Icerya larvæ that one sees on the walls of the jar on the side toward the light.

Pasteboard tablets in this form may be made up until the jar is filled to the top. Having reached this point and four to eight days having passed—that is, when it has become necessary to furnish new food—the tablets are distributed in new jars, placing one or two in each one and leaving one or two in the first jar to continue and develop the broods; or the tablets stocked with larval and winged Vedalias are utilized to establish colonies of the precious coccinellids in orchards, groves, and gardens invaded by Icerya.

In the first case the same system is followed with each new jar until it is full of tablets.

In the second case the jar with the material is taken where the colonies of Vedalias are to be established, and at each point the gauze which covers the mouth of the jar is loosened. One or more of the tablets is removed with their Iceryas and Vedalias. Each one is placed in a small box made of wood, of pasteboard, or of leaves of appropriate size (collar boxes serve every purpose), and these boxes are bound or nailed in an upright position to the trees or plants where it is desired to start the colony of Vedalias.

As the larval and also the winged Vedalias are very delicate and the lightest pressure crushes them, we should therefore always avoid touching them, in order to preserve the largest number possible in the broods. It is for this reason that we have contrived the simple process which we have described and which with good results is being followed in the chemical-agricultural station of Lisbon, both in the breeding and distribution of Vedalias.

In order to favor the breeding of Vedalias his excellency, counsellor Elvino de Brito, director-general of agriculture, ordered the construction at the chemical-agricultural station of a tent of wire-cloth over a wooden frame. This tent covers an orange tree infested with *Icerya purchasi*, and can be easily taken down and put up when necessary to change its place, and is operated in manner similar to the one which was established for the same purpose in the United States of America under the name of U. S. Propagating Station for Parasites of Scale Insects.

Within the tent is found, beside the orange tree infested with Icerya, a shelf on which are placed tablets, according to our system, with Iceryas, not only to furnish eggs and larvæ for the sustenance of the Vedalias because in a short time the Iceryas of the orange tree would be insufficient, but also for the purpose of utilizing these tablets, after stocking with coccinellids, to continue their colonization in localities or estates invaded by scales.

To stock this tent or station we presented to them early in May several large jars where we had made the first breedings, which contained about a thousand Vedalias in various stages. At the same time we furnished to the chemical-agricultural station, to serve in the distribution of Vedalia colonies, two large jars containing 12 tablets stocked with some thousands of the larvæ and winged forms of the voracious coccinellid.

With the breedings obtained in the chemical-agricultural station of Lisbon (Belem) and those that we had furnished to them, the station was advised to establish thirty-eight centers or colonies of Vedalias, fitted out so as to be able to continue, each time

with more intensity and rapidity, these colonizations in the orchards, gardens, parks, and country places of Lisbon and its environs. Proprietors who had plants infested with Iceryas and wished to utilize this convenient and economical means of combating them were to inform the director of the chemical-agricultural station, or the agriculturist of the district of Lisbon, or the director-general of agriculture.

It should be known that *Vedalia cardinalis* attacks only the larvæ and eggs of Icerya, and that one must not decide that it is not an active destroyer of this scale because we continue to see for some time adult Iceryas that were already on the trees when the colonies or centers of Vedalias were established there. The adult Iceryas continue, then, to live, and, until they die, to place eggs in their sacs, but the eggs and young larvæ of the Iceryas are the ones which are destroyed until a point is reached when none arrive at the adult stage. From this moment the white egg sacs of the Iceryas are left empty in the branches and leaves, and the invasion of the injurious scale has been overcome.

After the colonies of Vedalias are established in any locality or estate, it is advisable not to make treatments there nor in their proximity, in order not to destroy the young of the beneficial parasite of Icerya, which soon develop, because the adults spread about and lay their eggs, sometimes near at hand and sometimes at a distance, on the infested branches just below the colonies of Iceryas. For some time the larvæ of Vedalia are not strikingly apparent, except they are quite numerous, well developed, and fat. At first they live somewhat concealed, among the Iceryas or within the oviferous sacs of the latter, next to the eggs and tender larvæ just issued from the egg.

With the rapid development which the broods of *Vedalia cardinalis* have, and in view of the large number of colonies already established, of the many more numerous ones which will be established still during the summer and autumn, and in view of its wide distribution, it is to be believed that even in the coming year it will be difficult to find a tree with Icerya, in Lisbon or its environs, without finding there likewise its terrible enemy, *Novius* or *Vedalia cardinalis*. The treatment with insecticides, which has produced meanwhile good results, will become from that moment absolutely unnecessary, if it is not so already.

In the meantime, not being aware of the remarkable success in rearing the Vedalia from the six specimens remaining alive of our last shipment, the writer sent on June 29, by direct mail, a consignment of about 5 dozen larvæ of *Novius koebelei* and *N. cardinalis* which had been received in Washington that day through the courtesy of the State Board of Horticulture of California. On August 10 word was received from Senhor Le Cocq to the effect that the shipment reached him on the 13th of July, thus making the time from San Francisco to Lisbon only twenty days—less than one-half the time occupied by the preceding sending. It resulted from this short journey that adults of *Novius koebelei* reached Portugal in safety. There were twelve beetles of this species living on receipt, two of *N. cardinalis*, and some few larvæ.

In the same communication Senhor Le Cocq wrote as follows:

The propagation of the Vedalia received from you in November and December, 1897, has been wonderful, particularly that of the second package, which reached Lisbon December 19. The chemical-agricultural station of Lisbon, to which I committed the first package which you sent me and many thousands of those I bred at home, has already established several colonies in about ninety farms, orchards, parks, and gardens in Lisbon and in the country around Lisbon. In the orange orchard around the propagating station [described in the preceding quota-

tion from the "Archivo Rural"] the beetles and larvæ of Vedalia which have spread out upon the orange trees, upon the indian corn, upon grass, and upon the ground must be reckoned by the millions. It excels all I could expect and reasonably desire or hope for. The colonies of Vedalia are now being distributed profusely every day to many farmers and gardeners who ask for them, and you may believe that we justly consider how great has been the invaluable service and benefit you did to Portuguese agriculture and horticulture.

Later information has come to us in the columns of O Jornal de Lisboa of September 7, 1898, in a quotation from Novidades of the day before, from which we extract the following: "Colonies or stocks of Vedalias were established on not less than 487 estates, whence naturally many others were formed by radiation. Gardens and orchards that were completely infested and nearly ruined are to-day entirely clean, or well on the way toward becoming so."

It would thus seem as though the wonderful little *Novius cardinalis* has fully sustained in Portugal the great reputation which it had previously gained in the United States. The writer would not have been able to assist the Portuguese Government to this admirable result had it not been for the enlightened policy of the State Board of Horticulture of California in continuing the breeding in confinement of these predaceous beetles long after the apparent great necessity for such work had disappeared in California, and had it not been for the courtesy of the board in promptly placing material at the disposal of this office.

TWIG PRUNERS AND ALLIED SPECIES.

By F. H. Chittenden.

THE OAK PRUNER.

The attention of the curious is often attracted by numbers of twigs and small branches which sometimes strew the ground under trees of various kinds, particularly oak and hickory, and the observer is usually at a loss to account for their presence. The severed limbs vary in length from a few inches to two or three feet, and one cut limb is mentioned by Dr. Fitch in his article on this species (5th N. Y. Rept., pp. 797–804) that measured ten feet, and another that was 1¼ inches in thickness. He further remarks that young trees are sometimes felled by this insect. An examination of one, and sometimes of both ends of a severed limb will show a smoothly cut surface, near the center of which will be seen a more or less oval opening plugged up with a wad of a material composed of fine shavings and sawdust (see fig. 11, *e*, *f*). If one of these limbs be split open, a soft-bodied larva or pupa will be found resembling that shown in fig. 11, *a*. This is the larva of a Cerambycid or long-horned beetle, *Elaphidion villosum* Fab., generally known in literature as the oak pruner. This larva is subcylindrical, soft and fleshy, and of a whitish or light-yellowish color. It is provided with

legs (see *g*), which are, however, somewhat rudimentary and of little service to the creature as organs of locomotion.

The beetle is slender and cylindrical in form, dark brown in color, and clothed with grayish, somewhat mottled, pubescence. The antennæ of the female are shorter, those of the male (illustrated at *b*) longer, than the body; the proximal joints are armed with small spines. Each elytron terminates in two small spines and the femora are unarmed. The length varies from about a half to three-quarters of an inch.

The pruning process is not always in itself especially injurious, but the ultimate effects are apt to be more serious. The fallen twigs serve as a breeding place for hosts of other wood borers, many of which are

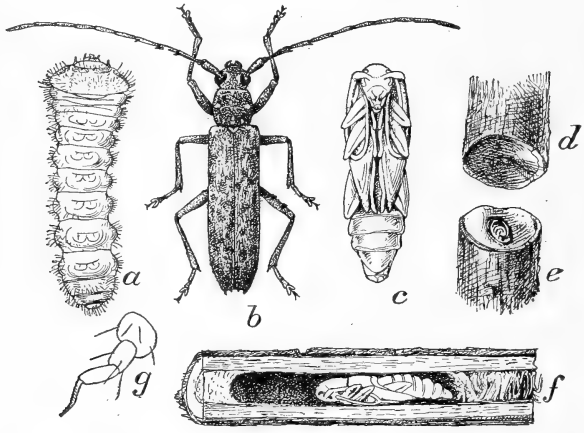

FIG. 11.—*Elaphidion villosum: a*, larva; *b*, beetle; *c*, pupa; *d*, end of twig excised by larva from tree; *e*, reverse end containing insect; *f*, same from side, split to show pupa within; *g*, leg of larva; *a*, *b*, *c*, about twice natural size; *d*, *e*, *f*, natural size; *g*, greatly enlarged (original).

injurious to timber. Among these are some which do not hesitate, in default of an abundance of dead wood, to attack and injure living trees.

LITERATURE OF THE OAK PRUNER.

Early in the present century an account of this species was given by Prof. William D. Peck in an article published in the Massachusetts Agricultural Repository and Journal, of January, 1819 (Vol. V, pp. 307–313). In this article Professor Peck gave the main facts in the insect's life history, bestowing upon it the popular name of oak pruner and describing the species as *Stenocorus putator*. In later times this species, together with *E. parallelum*, which is considered to be merely a synonym, has received treatment at the hands of most writers on economic entomology. Fitch, in his Fifth Report on the Insects of New York (pp. 17–24), furnishes an exhaustive article on the subject, dwelling at length upon the supposed marvelous intelligence of the insect. It is not within the province of the present article to discuss this latter

subject in detail, since it has been ably treated by Mr. Frederick Clarkson and the late Dr. John Hamilton, and the reader is therefore referred to their articles in the Canadian Entomologist (Vol. XVIII, pp. 188–190 and 141–144) and to the Fifth Report of the U. S. Entomological Commission (pp. 83–90), where the major portion of the accounts of Fitch and Hamilton are reproduced.

FOOD PLANTS AND INJURY.

The list of known food plants of this species, as recorded by the writer and others, includes: Oak, hickory, chestnut, maple, Abies (Haldeman, Trans. Am. Phil. Soc., Vol. X, p. 34), apple, plum, peach, grape, quince, locust, redbud (*Cercis canadensis*), sumach, orange, and Osage orange (*Maclura aurantiaca*). In past years the writer has seen pear trees very extensively pruned by this insect; also the climbing bitter-sweet (*Celastrus scandens*). More recently this or allied species have been ascertained to attack almost every woody plant that grows. In the vicinity of Washington the genus Elaphidion is not so abundant as in many northern localities, but pruned twigs of various trees and shrubs are of frequent occurrence, among which have been noted spicebush (*Lindera benzoin*), sassafras, sumach (*Rhus glabra* and *typhina*). Walsh mentions the occurrence of pruned twigs on English or white walnut and Fitch mentions beech* and birch.

An unpublished divisional note which adds a new food plant to this species should be inserted. In October of 1882 we received from Mr. M. C. Read, of Hudson, Ohio, specimens of twigs of Chinese Wistaria, which had been pruned by the larvæ which they contained. Adult beetles began issuing (in confinement) January 6, 1883.

Of reported injuries by this species Prof. A. J. Cook says (Entom. Amer., Vol. III, p. 59) that in 1886 "peach trees in portions of Michigan were seriously injured. The twigs were cut off so as to nearly destroy some of the trees." In Volume V of Insect Life (p. 50) mention is made of the extraordinary abundance of this pruner in Bucks County, Pa., and it is there stated, on the authority of Mr. J. B. Watson, that carloads of the branches could be gathered up from the ground through the oak forests.

In the writer's experience the oak pruner was extremely abundant in the early 80's in the neighborhood of Ithaca, Tompkins County, N. Y., and later near South Woodstock, Windham County, Conn., on the shagbark hickory, the severed twigs and branches occurring by the barrel-full under a single tree. In one instance pear trees in an orchard at Ithaca, N. Y., had been very extensively pruned by it. It had apparently attacked healthy living twigs, and several trees had every appearance of having been killed outright.

*The beech species is evidently, judging by Fitch's description of its work, the twig girdler, *Oncideres cingulata* Say.

Under the caption "Elaphidion injury," and evidently referring to the present species, Prof. J. B. Smith wrote in 1892 (Ent. News, Vol. III, p. 261): "One of the striking features noticeable now in riding through New Jersey is the unusual amount of Elaphidion injury on oaks. In some localities every tree has several dead or dying twigs, and the ground beneath is strewn with branches broken off by recent high winds."

A similar condition was observed and commented upon by Dr. Riley at about the same time in the country lying between Washington and New York City, and noticeable from the railway cars in traveling between those cities.

LIFE HISTORY.

From our present knowledge of this species the following brief account of its life-history may be given:

The mother beetle inserts an egg, usually in one of the smaller twigs of a living tree. The young larva hatching therefrom first attacks the wood under the bark, following the grain of the wood and packing its burrow with its sawdust-like castings. The larva as it grows bores toward the base, often consuming the wood entirely around the limb and ejecting its castings through holes which it makes in the bark. Later it follows the axis of the twig, boring through the center and excavating a more or less oval channel, sometimes for a distance of several inches. Dr. Fitch has said that the larva is only about half grown when it severs the limb in which it is working, but it has more probably attained its full growth at this time. He described this operation, recounting at length how, with "consummate skill and seemingly superterrestrial intelligence, he varies his proceedings to meet the circumstances of his situation in each particular case."

From Dr. Fitch's account it would seem that he imputed to this insect a reasoning power, which enables it to modify its operations according to the conditions, and to judge just how far the limb should be cut off to insure its ultimate amputation by the wind, without endangering its own safety. Whether guided by reason or by blind instinct, the insect is actually enabled to accomplish this purpose.

After cutting away the wood in such manner that the winds will in time bring the limb to the ground, the contained larva retreats into its burrow and plugs up the severed end with castings. Here it transforms to pupa (fig. 11, *e*, *f*), sometimes late in the autumn and often not until early spring, assuming the adult stage as early as November and appearing abroad in June and throughout the summer until September.

A larva received through the kindness of Dr. A. E. Brunn, from South Woodstock, Conn., transformed to pupa May 3, and to adult May 21, having thus passed the pupal stage in eighteen days, the average temperature having been about 74° F.

Although this species normally completes its transformations in amputated or fallen limbs, it occasionally breeds in limbs that have not been

severed. It does not alway cut off the twigs in which it lives, and the larva sometimes reverses the order of proceedings and directs its burrow toward the distal end of the branch, which it cuts off at the end of its burrow and remains in the branch attached to the tree.

From the earlier accounts of Fitch and others it would be inferred that the insect requires a single year only for the completion of its life cycle. Dr. Hamilton, however, states that a longer period is required, three years being the usual time, in individual cases four or more years being consumed. The writer is strongly inclined to believe such exceptionally long periods, even three years, to be the result of undue dryness caused by indoor breeding.

WHY THE LARVA AMPUTATES A LIMB.

The purpose of the larva in cutting away the wood furnishes an interesting topic for speculation. The object attained is its ultimate fall to the ground.

Peck thought that the limb, if permitted to remain attached to the tree, would become too dry and that a certain degree of moisture was required for the development of the insect, and that the limb was accordingly partially severed that it might eventually fall, and that then, lying on the ground amid the autumn leaves and beneath the winter's snow, the requisite degree of moisture was insured. In this belief Dr. Fitch concurred. Mr. Clarkson, however, takes issue with Fitch and believes that the main object of the larva is to obtain dead wood and to prevent the flow of sap. Here we have two contrary views expressed, one that the object is to obtain moisture, the other to prevent it.

Such an excess of moisture, as is obtained on the ground under the melting snow and the pools of water that collect in winter under the infested trees, could hardly be a necessity in the life history of any terrestrial animal. The ease with which these insects may be reared from dry twigs indoors is conclusive proof to the contrary. Why they should require more moisture than fifty or a hundred others that could be named that have similar food habits and do not breed exclusively in fallen limbs, it would be difficult to explain. Again, that the small flow of sap of oak or hickory could seriously interfere with development would seem unreasonable when we consider that these insects are able to survive the immersion to which they are sometimes subjected for days together during thaws and rainy spells in the winter.

Another explanation of the limb's amputation occurs to the writer. Those who have reared beetles from hard wood cannot have failed to observe that the larva before transforming cuts through the wood until it reaches the bark, which is left untouched and serves to protect the insect from marauding birds or other enemies. When the beetle develops it has only to gnaw its way through this thin layer of bark to effect its exit. There are undoubtedly some wood borers which are

provided in the beetle state with mandibles sufficiently powerful to enable them to penetrate hard wood (Monohammus, for example), but the majority, among them Elaphidion, are not thus favored, and would be utterly unable with their weaker boring organs to escape, and would perish in their burrows had they not, while larvæ, excavated the necessary channel for their exit. These exit channels usually run at an angle to the axis of the wood. Now, in the case of our Elaphidion, which usually lives in a slender limb which it bores longitudinally, there is no room to place a branching, transverse channel; accordingly the larva severs the twig and when it becomes a beetle it cuts its way through the plug of castings.

As to the larva apparently varying its operations to suit the different sizes of limbs, the average infested twig is of about the thickness of one's finger, and it is probable that the larva commences proceedings late in the season with the approach of cold weather when it is about full grown and ready for hibernation. To cut off the limb is a labor of some magnitude for so small a creature and may require several days for completion. It has a limited amount of energy, being now toward the end of its active existence as a borer, and the cooler weather serves to repress this energy, which is sufficient for cutting away all the wood in a small twig, but is inadequate for a larger one. The wood of a large branch is harder, and the insect ceases work, perhaps from exhaustion or from cold, or because its instinct impels it to cut a certain amount, and when that is accomplished to cease, its work being ended. At the close of his narrative Dr. Fitch says, in spite of a previous assertion that the insect never miscalculates, that—

> in at least three-fourths of the fallen limbs no worm is to be found; and an examination of them shows that the insect perished at the time the limb was severed and before it had excavated any burrow upward in its center, no perforation being present except that leading into the lateral twig. It is probable that in many instances the limb broke when the insect was in the act of gnawing it asunder, either from its own weight or from a wind arising whilst the work was in progress.

As might be inferred from the manner of life of this insect, it enjoys as nearly perfect exemption from predaceous or parasitic attack as falls to the lot of any wood borer. Fitch, however, has stated that some of our insect-eating birds destroy the larvæ, and the writer has reared the parasite *Bracon eurygaster* Brullé from twigs inhabited by the species.

REMEDIES.

In case this species becomes injuriously abundant, it may be readily controlled by gathering the infested twigs during the winter and burning them before the following spring.

The following summary of the known food and other habits of other species of Elaphidion is appended:

THE ORANGE SAWYER.

Of this species, *Elaphidion inerme* Newm., the late Dr. Riley has stated (American Entomologist, Vol. III, p. 238) that the perfect insect was cut by Mr. E. A. Schwarz from dry twigs of *Quercus virens* at Enterprise, Fla. In Bulletin No. 1, first series, of this Division (p. 9), Mr. H. G. Hubbard gave a few notes on this species, and in his special divisional bulletin "Insects Affecting the Orange" (pp. 125–127) presented a few additional facts, proposing for the insect the name of orange sawyer. The injuries caused by this Elaphidion to orange trees result from careless pruning, from failure to properly trim the dead end of the stock above the insertion of the bud. These ends attract the female beetle, which deposits one or two eggs in each. The larvæ hatching from these confine their work to the dead ends until they are completely hollowed out and reduced to mere shells packed with castings. When the supply of dead wood becomes exhausted, the larvæ descend into the living wood and thus weaken the bud, if they do not kill it outright by undermining the tissues which support it. One of the twigs sent by Mr. Hubbard to this office has every appearance of having been pruned, but not in the usual smooth manner as performed by the oak pruner.

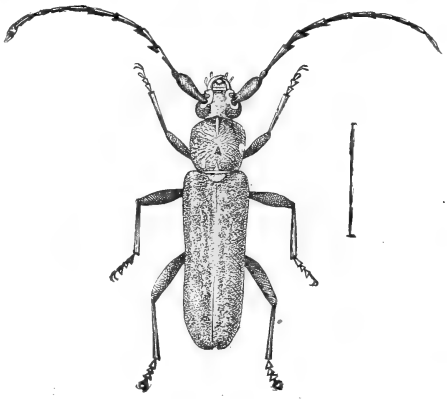

FIG. 12.—*Elaphidion inerme:* enlarged 2½ times (from Hubbard).

The adult beetle is shown at figure 12. It is of much the same appearance as *villosum;* the antennæ are comparatively shorter, never longer than the body, the spines small. The femora are not spinose. The thorax has a small median smooth spot and no dorsal callosities. The tips of the elytra are truncate and do not bear spines. In well-marked specimens the pubescence is arranged in a large white patch on the humerus and another across the middle of each elytron.

FIG. 13.—Work of *Elaphidion subpubescens:* natural size (original).

ELAPHIDION SUBPUBESCENS Lec.

On July 15, 1894, Mr. Th. Pergande found larvæ boring in shoots of white oak (*Quercus alba*) which were growing about the base of oak stumps, from which the perfect insect was reared June 15, of the following year. According to Mr. Pergande, who has kindly furnished me with his notes on the subject, the larva selects, by preference, shoots

which are not above a quarter of an inch in diameter, although sometimes they are found to attack shoots of double this size. As a rule, the larvæ bore nearer to one side than the other, though often but little more than the thin bark is left in the smaller shoots. There is evidence that the species is a perfect pruner, and appears to confine its attack to upright shoots when these are obtainable. A remarkable feature of the work of this larva, and one apparently peculiar to it in its regularity, is its habit of forming on the underside of the twig which it infests a more or less continuous and regular row of circular holes. These are evidently for the purpose of expelling the excrement of the insect as fast as it forms, since no pellets are to be found in the burrows, while numerous bits of excrement may be seen scattered about underneath infested shoots. In a small shoot that has been preserved (illustrated herewith) in a space just 2 inches in length, an even twenty of these little holes have been formed at very regular intervals and in a nearly straight line, and several other small twigs present a similar appearance. In larger twigs the holes are less regularly placed, are larger, less numerous, and more widely separated. The holes in the smaller twigs measure from 0.6 to 0.8 of a millimeter in diameter, and those in the larger twigs are fully twice as large An approach to this habit is observable in the common oak pruner.

The larva begins operations very near the tip of a shoot, bores sometimes also for some distance into the side shoots, and afterward penetrates the entire length of the main shoot, making its way into the stump itself where it forms its pupa in the more solid wood. The larva resembles that of other species of Elaphidion, having distinct thoracic legs. It has unusually long hairs at each side of the mouth.

Fortunately this species is a very rare one, as it would be quite capable, Mr. Pergande believes, of serious injury, should it ever be sufficiently numerous in nurseries.

The beetle is of about the same size as *villosum*, but is much narrower. The entire surface is very coarsely punctured, and sparsely and uniformly pubescent. It has previously been recorded from New Jersey and Texas.

ELAPHIDION MUCRONATUM Fab.

Elaphidion mucronatum Fab. has been found in dry twigs of live oak (*Quercus virens*) and in the dry leaf-stems of the cabbage palmetto (*Chamærops palmetto*) in Florida, in healthy hackberry trees in Texas, and in large limbs of wild grapevine (Am. Ent., Vol. III, p. 239). Prof. J. B. Smith writes that he has reared it from the stems of young trees or from larger branches of oak which had been girdled, and that it bores "clear down to the roots." The writer has reared it from large branches and trunks of redbud (*Cercis canadensis* and *japonica*) and Dr. A. D. Hopkins (Bull. 22, W. Va. Agl. Ex. St., p. 193) states that it "infests dead bark and wood of beech," the "green wood of living

sugar maple and bark of black oak." This species is not a pruner, at least as far as observation goes. There is a divisional note on its having bred February 8, 1889, from a piece of dogwood (Cornus) which had been stored in a carpenter shop some years to be used for hammer handles. The larvæ had worked principally under the bark where they produced large and irregular channels, entering, when nearly full grown, the solid wood, in which they transformed.

The adult insect, represented at figure 14, is similiar in form, size, color, and pubescence to *villosum*. The antennæ and elytra differ in being armed with much longer spines; the femora are also spinose. The antennae of the male are longer than the body. This is our commonest northern Elaphidion, next to *villosum*.

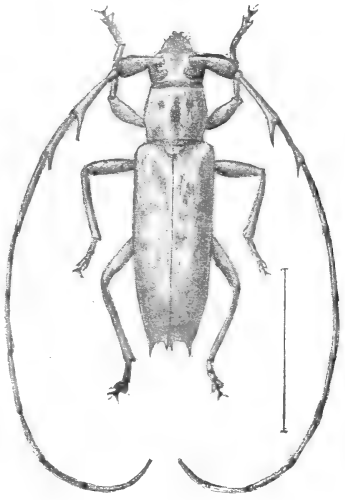

FIG. 14.—*Elaphidion mucronatum*: enlarged 2½ times (original).

HABITS OF OTHER SPECIES OF ELAPHIDION.

E. tectum Lec. (?)—The stems of Yucca are sometimes attacked by what Mr. A. Bolter supposed was perhaps this species. (Trans. Acad. Sciences St. Louis, Vol. III, p. 568).

E. cinereum Ol., is an inhabitant of the West Indies, but is also very abundant at Key West, Fla. Mr. Schwarz has discovered that this species develops in the branches of the buttonwood, *Conocarpus erecta*. (Pr. Ent. Soc. Wash., Vol. I, p. 93.)

E. irroratum Fab. inhabits the trunk of the black mangrove (*Avezinnia nitida*) in Florida (Hubbard, Am. Ent., Vol. III, p. 239), and the white mangrove (*Laguncularia racemosa*), (Schwarz, Proc. Ent. Soc. Wash., Vol. I, p. 93).

E. unicolor Rand.—Dr. Leconte has recorded this species as occurring in the Judas tree or redbud (Cercis) (Trans. Amer. Ent. Soc., Vol. IX, p. iii).

A twig of plum was found by the writer at Colonial Beach, Va., July 13, 1897, that showed castings of a larva on the amputated end remaining upon the tree. When this was cut open, a living beetle was found within.

E. imbelle Lec. has been reared from oak in California (J. J. Rivers, Bul. Calif. Acad. Sci., Vol. II, p. 70, etc.).

A DESTRUCTIVE BORER ENEMY OF BIRCH TREES, WITH NOTES ON RELATED SPECIES.

By F. H. Chittenden.

INJURY AT BUFFALO, N. Y.

Serious injury to birch trees in the city of Buffalo, N. Y., has been reported the past fall, due to the ravages of the larvæ of a buprestid beetle hitherto practically unknown as a destructive enemy to this genus of trees.

In a letter dated October 13, 1898, Mr. M. F. Adams, of Buffalo, wrote that an insect, which was afterwards identified as *Agrilus anxius* Gory, was doing great damage to birch trees in that city. Specimens of infested European white birch, *Betula alba*, showing the mines of the larvæ under the bark, were received, and later specimens of the beetles and larvæ. A few years ago our correspondent noticed this same borer destroying a common white birch, *Betula papyrifera*. At that time the cut-leaf weeping birches, with the exception of a few trees in close proximity to the infested ones, were not infested, and he was of opinion that these trees had not been attacked until recently. White birches of every description in the city have since been destroyed, and not many trees that remain standing are entirely free from infestation.

Through the medium of the daily press of Buffalo the matter has aroused widespread attention in that city.

So much of value was obtained from Mr. Adams, through constant correspondence during the months of October and November, that it was not considered necessary at this time for anyone connected with this Division to make a personal inspection of the premises, particularly since little of value is to be accomplished in the line of an investigation of the life history of the species until the springtime, when the larvæ complete their growth and their transformation to pupæ and adult beetles.

Our correspondent has expressed the belief that if radical measures are not adopted the loss of every birch in the city of Buffalo in the near future is imminent. This insect has already destroyed the common white birch and, as previously remarked, many of the cut-leaf and European white birches. It even attacks trees planted but a year before.

That this opinion is justified we have only to cite similar instances of recent injury by this same insect at Detroit, Mich., which will be mentioned farther on, and by the related species, *Agrilus bilineatus*, the two-lined chestnut borer, to chestnut and oak in various parts of our country, and by the sinuate pear borer to pear in New Jersey.

That injury was due to a species of Agrilus could readily be made out from the larvæ and from the appearance of the burrows under the birch bark. At our request Mr. Adams made diligent search for the parent beetles, which often die in their burrows in the wood, with

the result that on November 10 some fragmentary specimens were secured, among which was fortunately a male, which proved the species to be *Agrilus anxius* Gory.

The notes which follow concerning the occurrence of this insect on birch at Buffalo have been brought together from data kindly furnished by Mr. Adams, to whom great credit is due for his zeal in the matter.

Injury can be detected in the trunk by a reddish discoloration from one-quarter to one inch in width, this being caused by the exudation of sap and the ejectment of excrement. Another indication of the insect's presence is the dying of the trees at their tops. The insect appears to attack the tree at first among the larger branches at a considerable height, causing the tree to die at the top while the remaining lower branches keep green. Its presence is also manifested by the uneven, wavy appearance of the bark, which shows more or less regular spiral ridges on the smaller branches. (See fig. 15.) The borer larva makes an opening through the outer bark of a size a little larger than a pin head. It then mines farther on beneath the bark, and there rests in a cavity which it prepares for its transformation not far from this discoloration. In cases where the inner bark is not thick enough, or where it happens to be dead, the larva enters the wood instead of making, as before, its cavity for pupation in the bark, being inclined apparently to avoid dead tissue, either wood or bark.

In the samples of work received the galleries of this borer larva run so closely together, often crossing and recrossing in such endless confusion that it is impossible to trace any individual burrow. A sample of the work is illustrated at figure 16. The galleries made by the mature larva measure about an eighth of an inch in width (3 mm.). It is the normal habit of the larva to leave its castings in the galleries as it works, as shown in the illustration.

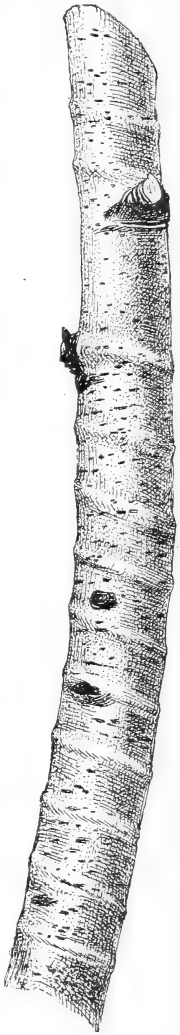

FIG. 15.—Work of *Agrilus anxius* on limb of white birch—somewhat reduced (original).

The larva, as a rule, enters the wood in the fall and there constructs a cavity, which probably serves the purpose of a pupal cell, in which it passes its ultimate transformations in late spring or early summer. Within this cell the larva passes the winter. In those individuals before the writer the caudal extremity of the larva is pointed downward, and the head and thoracic and first abdominal segments are doubled back upon the other segments in a position which he has not observed in any other larva, but this is probably the normal habit of

the genus and perhaps of allied genera. So nearly torpid were the larvæ when received and taken from their burrows, even in a well warmed atmosphere, that they appeared as if dead, some of them remaining motionless for a long time.

In many instances it was noticed in the larger branches, which were perhaps from 1½ to 1¾ inches in diameter, that the mines had penetrated to the center of these branches, and in some cases went through them. In no instance was it found that the parent insect deposited her eggs in branches smaller than one-half to three-fourths of an inch in diameter.

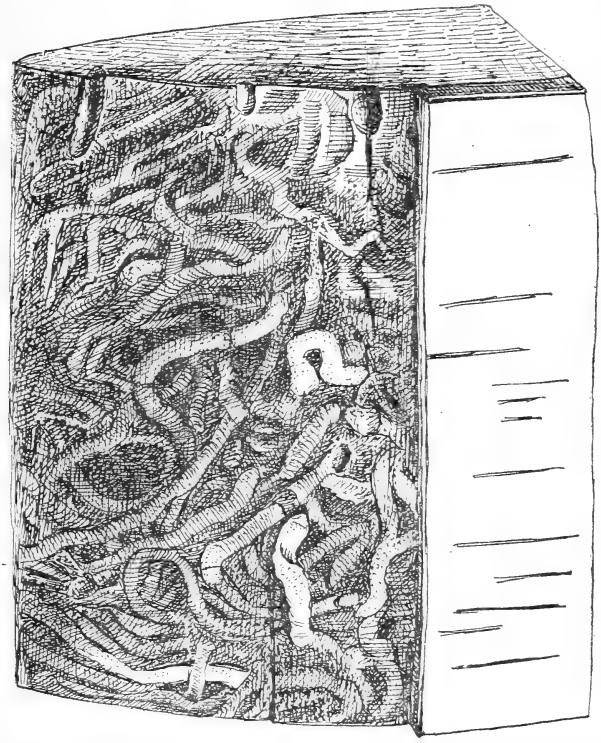

FIG. 16.—Work of *Agrilus anxius* on trunk of white birch, bark removed to show larval galleries—somewhat reduced (original).

During November no larvæ could be discovered in dry wood, but were found in wood which retained moisture, even when it had been cut down for nearly a year.

Writing November 14, Mr. Adams stated that he had just learned that the Forest Lawn Cemetery at that city had been badly infested by this species, and that about fifty of the birch trees had been removed during the past two years, the cause of the injury not having been known until the attention of the authorities was called to it by our correspondent.

Mr. Adams's observations lead him to the belief that the beetles issue in greatest numbers from the trees, beginning in the last week of June; but as several other species of Agrilus, as well as many other borers which inhabit the same latitude, issue from two to four weeks earlier, it seems probable that the earliest date of issuance remains to be observed.

It was noticed that one of our common woodpeckers, undoubtedly the hairy woodpecker, *Picus* (*Dryobates*) *villosus* Linn., as well as could be ascertained without capturing or shooting a specimen, fed quite

extensively upon the larvæ of this birch-tree insect. This bird selects a place on the trunk of the tree in which the larvæ are concealed and makes an incision in the bark which resembles that made by a pen-knife if stuck into the bark in the same manner. This it does until it locates the borer, when it proceeds to pick open the bark and remove the insect.

As in the case of injury ascribed to the two-lined chestnut borer, there is still a certain degree of doubt as to whether or not this birch borer is really the primary cause of the death of the trees. Our correspondent is of the opinion that injury in Buffalo is due primarily to the attack of this borer, since it has been observed attacking vigorous trees.

That carelessness is one of the principal causes that has led to its undue multiplication is evidenced by information furnished by Mr. Adams. He states that the upper part of the tree in which it was first noticed at work had been removed, but that about six feet of the trunk was permitted to remain for use as a support for flower vases or for some similar purpose. A surface as large as this would furnish opportunity for the development of perhaps many hundreds of this insect. The material from which the identification of the species was made was obtained by searching among wood piles which had been permitted to accumulate.

It is not improbable that woodpeckers and other birds would keep this borer in check if unmolested by sparrows, and this invasion may be accounted for, in a measure at least, by the absence of the insect's natural enemies.

A very singular thing in connection with the occurrence of this borer in birch is that in spite of frequent search, extending over a period of two years, our correspondent has been unable to find this insect attacking any other tree than birch—a remarkable condition of affairs when we consider the numerous observations by careful observers of its occurrence on poplar and willow.

DESCRIPTION AND DISTRIBUTION.

Agrilus anxius is shown in the accompanying illustration (fig. 17, *a*). It is a rather large species of its genus, measuring between three-tenths and nearly half an inch in length (7.5–11.5 mm.). It is of moderately robust form, subopaque, olivaceous bronze in color. The last ventral segment is oval at the apex; the punctuation of the prothorax is transversely strigoso-punctate and its posterior angles are carinate in both sexes; the first ventral segment in the male is broadly grooved; the second more deeply, the groove being narrow and smooth (see *b*). The serration of the antennal joints begins with the fourth joint. The elytra bear each a rather vague longitudinal costa and the scutellum is transversely carinate.

As no common name seems to have been applied to this insect, it may be called the bronze birch borer.

The accredited distribution of *Agrilus anxius* as redescribed by Horn (Trans. Amer. Ent. Soc., Vol. XVIII, p. 306) is "Massachusetts and New Hampshire; westward to Colorado."

In the collection of the National Museum and that of Messrs. Hubbard and Schwarz and of the writer the following localities for this species are taken, with addition of some that have already been recorded: Mount Washington, N. H.; Boston and Plainfield (?), Mass.; Buffalo, Ithaca, "Adirondacks," Elk Lake, and elsewhere in New York; Allegheny, Pa. (Hamilton); Lake Superior, Marquette, Detroit, Agricultural College, and Port Huron, Mich.; Stone Creek, Va.; Province of Quebec, near Ottawa (Harrington).

The larva.—The larva (fig. 17, *c*) resembles that of other species of its genus, being elongate, flattened, the first thoracic segment—which is apt to be mistaken for the head, the latter being retractile within it—rather prominent, and the anal segment terminating in a pair of slender corneous forceps-like processes. The color is creamy white, the mouth parts dark brown, nearly black, the remaining portion of the head, the first thoracic, and the anal segments being darker yellow. Being footless, the dorsal and ventral surfaces do not differ so noticeably as in many larvæ.

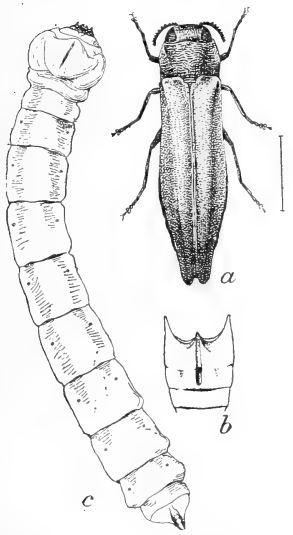

FIG. 17.—*Agrilus anxius*: *a*, female beetle; *b*, first abdominal segments of male from below; *c*, larva from above—all enlarged about 3½ times (original).

In the absence of a large series of the larvæ of other species of Agrilus, a specific description need not be attempted at the present time, particularly since all of the examples of this species which we have are freshly killed, and the material in other species is alcoholic and has, for the most part, been preserved for several years.

The larvæ at hand appear to be unusually stout, but it is possible that this may be accounted for by the fact that they had gone into hibernation and are unable to recover from their torpor. They are between five and six times as long as wide at the widest abdominal segment.

The first thoracic is of about equal width with the widest abdominal segments; the second and third thoracic are a little narrower; all of the abdominal segments are subequal except the last two, the penultimate being about the same width as the second and third thoracic. The anal segment does not appear to differ from that of other species, the fork being of the same shape and bidentate on the inner surface.

The length is a little less than three-fourths of an inch (17–18 mm.) and the width is a trifle less than an eighth inch (2–7 mm.).

The identification of this species as an enemy of poplar, and what appears to be the first record of its food habits, was made by the late Dr. Lintner in his report as State entomologist of New York for 1883 (p. 50), the observation having been made at Elk Lake, Essex County, N. Y. It is as follows:

> Upon some cut poplars (*Populus tremuloides*) piled by the wayside a large number of a wood-boring beetle, *Agrilus torpidus* (Lec.), which I had never met with before, were observed alighting from their flight in the bright sunshine and running in jerking motions actively over the bark. Its larva is doubtless a borer in the poplar. Sixty-two examples of it were taken.

Practically the same statement is repeated in the same writer's fifth report (p. 283). Again, in his tenth report (p. 407), this same occurrence is referred to, the original identification of the species as *torpidus* being altered to *anxius*, as the latter is now known to be a synonym.

Mere mention is made of what is probably this species by Mr. W. H. Harrington, who includes *Agrilus torpidus* (?) in his list of insects taken on willow, published in the Canadian Entomologist for June, 1884 (Vol. XVI, p. 101).

In the list of the Buprestidæ of Massachusetts compiled by Dr. Frederick Blanchard and published in Entomologica Americana (Vol. V., p. 32, Feb. 1889) appears the following concerning this species, also mentioned as *torpidus* Lec.: "A few specimens were taken on the summit of Mount Washington, New Hampshire, whither they had flown from below. The form described as *gravis* occurs in Massachusetts on poplar sprouts and trunks."

In Insect Life for October, 1891 (Vol. IV, p. 66), Mr. G. C. Davis considers this species in its aspect as an enemy of willow growing at Agricultural College, Michigan, as follows:

> Galls made on branches of the willow, *Salix discolor*, by *Agrilus torpidus* have been found quite common in certain districts near here, and in other districts was found *Saperda concolor* in galls equally as numerous. In no case yet noticed have the two been found in close proximity. The galls made by the Buprestid are an oval swelling of the live branch very similar to the one made by Saperda. Inside there is a difference in the architecture of the home. While the Saperda remains mostly within the swelling and makes its exit through it, the Agrilus bores an oval gallery downward from the gall, sometimes in the pith, but oftener indiscriminately through the wood, and makes its exit often an inch and a half below. The imago issued about a month later than the Saperda.

Our first positive notice of attack upon birch appears to be that of Mr. E. A. Schwarz, of this Division, who mentions this species in connection with injury ascribed to the scolytid, *Xyloterus politus* (Proc. Ent. Soc. Wash., Vol. II, p. 78). In the case mentioned, trees of silver birch, *Betula alba*, were destroyed at Detroit, Mich. Mr. Schwarz is now of the opinion that this Agrilus was probably the insect responsible for the subsequent destruction of all the trees of this species known to be growing at Detroit.

In 1896 Mr. J. G. Jack published in Garden and Forest (July 1, 1896, p. 269) a short account of injury to birch trees in the Arnold Arboretum at Plainfield, Mass., from which the following, having reference probably to this species, is copied:

> Some of the foreign birches in the arboretum and other localities about Boston have been killed by the attacks of boring larvæ, of a beetle belonging to the genus Agrilus, and probably an introduction from Europe. The insect bores into the trunk and limbs, ultimately killing the tree. Its presence is often indicated by a slight swelling of the bark.

Among the writer's collecting notes, made previous to his connection with the Department, is one of the capture of this species July 20, 1884, on willow, associated with *A. politus* Say, the latter a well-known willow borer, being observed in greater abundance. This is briefly mentioned as a willow species in Entomologica Americana (Vol. V, p. 220, Dec., 1889).

To this must be added reference to a note which appeared in letter form under various titles over Mr. Adams's signature in the Buffalo (N. Y.) daily journals of October 9 and 10, 1898. In this letter Mr. Adams called particular attention to the value of the early destruction by burning of all dying or injured birch trees in the infested locality. The identification of the depredator as a species of Agrilus was first made public through a short letter addressed to Mr. Adams by Mr. C. L. Marlatt, of this Division, and published in the proceedings of the board of park commissioners of the city of Buffalo. (Buffalo News, Nov. 7, 1898.)*

METHODS OF CONTROL.

From our present knowledge of the life habits of this insect there are only two methods of control indicated. These are clean cultural practice and the employment of precautionary measures which will serve the purpose of deterring the insects from depositing their eggs upon the trees and from effecting their egress through the bark of infested trees.

It is not probable that the trees can be saved after the borers have once taken possession of them, and the only thing to do is to cut down and destroy them by burning before the following May or in time to prevent the issuance of the adult beetles in June. It is of prime importance that the utmost care be observed to effect the destruction of all dead and dying trees before the time for the beetles to issue for the deposition of their eggs in the early summer, and this applies to every bit of wood of birch, poplar, and willow that may be infested or that may harbor this insect and thus prove a center of infestation to healthy or uninfested growth.

Some species of Agrilus have been observed to feed freely upon the upper surface of the leaves of their host trees, and it will be worth

* Since the present article went to press a few similar letters have appeared.

while to ascertain to what extent the beetles of this birch borer feed upon the foliage of birch, willow, and poplar, as it may be possible to reach many in this way by spraying freely with a solution of Paris green, applied at the rate of a pound to 100 or 150 gallons of water. Uninfested trees may be protected by various mixtures, a rather full list of which has been published in Circular No. 24, second series, of this Division, copies of which will be sent to anyone desiring them. In addition to the preventives there described, it may be stated that Mr. Adams is advising a mixture of resin and unboiled linseed oil. This he uses at the rate of 4 pounds of resin to 1 quart of oil, the resin melted and the oil poured in while hot. The resin can be obtained in lots of 4 pounds or more at 2 cents a pound, and the oil in single gallon lots at 40 cents a gallon. It may be applied to the trunk and branches with a paint brush.

Dendrolene, raupenleim, and similar dark-colored mixtures, although of value against related borers, as, for example, the sinuate pear borer, are hardly to be recommended for birch trees with white bark, as they mar the beauty of the trunks. Light-colored mixtures are preferable, and it is possible that a considerable measure of protection would be afforded by a thick whitewash poisoned with a small quantity of some arsenite, such as arsenate of lead. There is danger in the application of a strong arsenical to young trees, but it will not harm trees of older growth.

In some instances it might pay, for the protection of valuable trees in private grounds, and for paper birch and trees with similar rough, papery bark, to cover the trunks thoroughly with paper wrappings and whitewash or otherwise treat the branches.

A mixture of hydraulic cement and skim milk of the consistency of thick paint is worth the experiment against this insect, as it has been found of value against the peach-tree borer.

The preventives used should be applied to the trees just before the issuance of the beetles, which may be, in some localities at least, as early as the latter days of May. If paper wrappings are used they can be removed as soon as the danger season is passed, which will be within two or three months of the time of first appearance of the beetles. If cement be the remedy employed it should be broken up with a broom or stiff brush as soon as the danger time is over; it is imperative that the cement be not left on the bark of young, growing trees longer than is necessary, as its presence might interfere with the tree's growth.

A measure of utmost value for the protection of trees from the attacks of borers consists in keeping them in the best possible condition, free from fungi, moss, or abnormal growth, from loose bark, and, in short, keeping the trunks as clean as possible. In some cases the use of a fertilizer might assist the trees to withstand borer attack.

A NEW NOMENCLATURE FOR THE BROODS OF THE PERIODICAL CICADA.

By C. L. Marlatt.

The writer reviewed the different nomenclatures suggested by various authors for the broods of the periodical Cicada in Bulletin No. 14, new series, of the Division of Entomology, and therefore a brief summary of the old systems is all that need be given here.

It will be remembered that the earlier writers, viz, Prof. Nat. Potter, Dr. William T. Harris, and Dr. G. B. Smith, classified the broods solely according to the years of their appearance. The unpublished register left by Dr. Smith includes every brood now known classified according to race, and gives the localities for one additional brood, the existence of which seems not to have been confirmed. Though lacking any special designation for the broods, Dr. Smith's classification is as complete and accurate as that published by Dr. Riley and since followed by all later writers. Dr. Asa Fitch was the first to introduce a numbering system for the different broods, enumerating nine altogether, but his data was very limited and he was not aware of the 13-year southern period, and there necessarily resulted no little confusion of the broods of the two races. The Walsh-Riley enumeration of 1868 gave the records for sixteen broods, which were designated by roman numerals from I to XVI, the enumeration being based on the sequence of the different broods after 1868. In 1869, in his First Missouri Report, Dr. Riley, having in the meantime secured the manuscript paper of Dr. Smith, added the six broods from this paper not represented in the Walsh-Riley enumeration, increasing the number of the broods to XXII, and renumbered them again in accordance with their sequence, beginning with 1869. Several of these broods are rather unimportant, or lack confirmation, and one of them, Brood III, was founded on an erroneous record and has been dropped.

In the enumeration of the broods by Walsh-Riley, and later by Riley, the two races are mixed together and a sequence of numbers given, which, after the first thirteen years, lost all significance as a record of the order of the broods in time of appearance, and from the first obscured the true kinship of the broods in each race. If, on the other hand, each race be considered separately and its broods be arranged in a series in accordance with their sequence in time, an important natural relationship in point of origin and distribution is plainly indicated.

Taking first the broods of the 17-year race, it will be seen from the subjoined table that if the enumeration begin with Brood XI, the 17-year broods follow each other in regular succession for eleven consecutive years; then after a break of one year follows Broods V and VIII, and after another break of one year, Brood IX; another break

of one year precedes the next recurrence of Brood XI, with which the series starts:

Chronological order of the broods of the Cicada from 1893 to 1910.

Year.	17-year race.	13-year race.	Year.	17-year race.	13-year race.
1893	XI	XVI	1902	XXII	.....
1894	XII	XVIII	1903	I	.....
1895	XIII	II	1904	.....	.....
1896	XIV	IV	1905	V	.....
1897	XV	VI	1906	VIII	XVI
1898	XVII	VII	1907	.....	XVIII
1899	XIX	.....	1908	IX	II
1900	XX	.....	1909	.....	IV
1901	XXI	X	1910	XI	VI

Taking up the 13-year broods in the same way, it will be seen that if the enumeration start with Brood XVI, a 13-year brood follows in regular succession for six years. With the exception of the very doubtful Brood X, which is separated from the last 13-year brood by three years, there follows seven successive years in which no 13-year broods occur.

Under the supposition that the different broods of the 17-year and 13-year races sprang in the remote past from an original brood of each, it would naturally follow that the broods most closely related in time would also present a closer relationship in their range, and this, in fact, proves to be generally true.

To show this relationship and to indicate the natural order of their occurrence, I have to suggest a new enumeration of the broods in which the two races are separated—the 17-year broods coming first, followed, for convenience merely, by the 13-year broods. Thus Brood XI of the 17-year race becomes Brood I, and the others are numbered in the regular order of their occurrence, except that I have assigned a brood number to each of the seventeen years. This leaves Broods XII, XV, and XVII, as newly numbered, without any definite colonies, so far accepted, as representatives of established broods. As will be shown later, however, there are records which indicate the existence of small or scattering broods filling the three gaps mentioned in the 17-year series.

In the renumbering the broods of the 13-year race I have continued for convenience from the end of the series of the 17-year race, the first 13-year brood becoming Brood XVIII, and I have assigned brood numbers to each year of the 13-year period, making a total enumeration of the broods of both races of XXX. As already indicated, six of the numbers given to the 13-year race have had no brood assigned to them, although records have been secured which seem to indicate the existence of scattering broods filling some of the gaps, as will be noted in the records given further on.

It does not necessarily follow, in fact it is quite unlikely, that Brood

I, as here designated, is the original or oldest brood of the 17-year race. Undoubtedly some of the 17-year broods, perhaps half or more of them, originated by retardation of individuals, and perhaps half by acceleration of individuals; so that the original brood, if it still exists, is more likely to be one of the intermediate ones. Brood X, being the largest of the 17-year broods, perhaps has best claim to this distinction.

For the same reasons an intermediate brood in the 13-year series is doubtless the original brood of the 13-year race, and this title may possibly belong to Brood XIX which has the widest range of all the broods of the 13-year race. The fewer number of broods in this race would seem to indicate that it is of later origin than the 17-year race, and this belief is further justified by the fact of its occupying, in the main, a territory of later geological formation.

The following table, beginning with 1893, when the initial broods of both the 17-year and the 13-year series appeared in conjunction, illustrates the new nomenclature suggested, and in parallel columns also are given the corresponding nomenclatures proposed by Professor Riley, by Walsh and Riley, by Fitch, and the year records in Dr. Smith's register:

Nomenclature of the broods of the periodical Cicada.

Year.	Broods of the 17-year race.					Broods of the 13-year race.				
	Proposed enumeration.	Riley numbers.	Walsh-Riley numbers.	Fitch numbers.	Smith register.	Proposed enumeration.	Riley numbers.	Walsh-Riley numbers.	Fitch numbers.	Smith register.
1893	I	XI	.....	.....	1842	XVIII	XVI	.....	.....	1854
1894	II	XII	VIII	1	1843	XIX	XVIII	XIII	3	1842–1855
1895	III	XIII	IX	.....	1844	XX	II	.....	.....	1843
1896	IV	XIV	X	.....	1845	XXI	IV	.....	.....	1844
1897	V	XV	XI	.....	1846	XXII	VI	IV	.....	1845
1898	VI	XVII	XII	7	1847	XXIII	VII	V	5	1846–1859
1899	VII	XIX	.....	.....	1848	XXIV	.....	.....	.....	.....
1900	VIII	XX	XIV	2–8	1849	XXV	.....	.....	.....	.....
1901	IX	XXI	XV	5	1850	XXVI	X	.....	.....	1849
1902	X	XXII	XVI	4	1851	XXVII	.....	.....	.....	.....
1903	XI	I	I	9	1852	XXVIII	.....	.....	.....	.....
1904	XII	.....	II	.....	1853	XXIX	.....	.....	.....	.....
1905	XIII	V	III	6	1854	XXX	.....	.....	.....	.....
1906	XIV	VIII	VI	3	1855	XVIII	XVI	.....	.....	1854
1907	XV	.....	.....	.....	.....	XIX	XVIII	XIII	3	1842–1855
1908	XVI	IX	VII	.....	.....	XX	II	.....	.....	1843
1909	XVII	.....	.....	.....	.....	XXI	IV	.....	.....	1844

THE RELATIONSHIP OF THE DIFFERENT BROODS.

As a rule the relationship of the broods in point of distribution agrees with their kinship as indicated by their sequence in time of appearance. The relationship indicated by the latter, viz, their sequence in time, is doubtless untrustworthy as indicating origin, in some instances, on account of the uncertainty arising from the action of the principle of retardation on the one hand and acceleration on the other in the forming of new broods.

In the case of a widely scattered brood, like Brood VI, it is quite

possible that certain swarms originated from a later-appearing brood by retardation of individuals, and other swarms from an earlier brood by acceleration in time of appearance of individuals.

This same condition may be true of other of the more scattered broods, but with the broods presenting a compact range a singleness of origin is evident.

Examination of the distribution of the broods in connection with their sequence in time of appearance indicates, however, a certain relationship between the different broods in point of origin, which may be indicated as follows:

THE RELATIONSHIP OF THE 17-YEAR BROODS.

From the standpoint of distribution the broods of the 17-year race may be grouped as follows: (1) Broods I and II; (2) Broods III and IV; (3) Brood V; (4) Brood VI; (5) Broods VII, VIII, IX, X, and XI; (6) Broods XII, XIII, XIV, and XV; (7) Broods XVI and XVII, the last connecting again with Brood I.

Taking up these broods in regular order:

The main body of Brood I occupies territory immediately west of the more important Brood II, and also presents a number of colonies extending westward to Colorado. Broods I and II seem, therefore, closely allied in point of origin.

Brood III presents little, if any, relationship to Brood II in point of location and distribution, but is closely allied to the following brood, IV, and the latter is evidently a western and southern extension of III.

Brood V presents little relationship with Brood IV in point of distribution and covers a very compact territory.

Brood VI, being a widely scattered one, and occurring usually in small numbers, does not seem to present any particular relationship with any of the preceding or following broods.

Brood VII is local in distribution and not very important, and is divided into two sections by the territory occupied by the following Brood VIII, with which it thus seems to be closely allied. Brood IX is very distinctly a southern extension of Broods VII and VIII. These three broods seem, therefore, to be closely allied in their origin, and, curiously enough, occupy territory which divides the two main sections of the great 17-year Brood X, which next follows in regular succession. Brood XI, following X, is evidently an extreme northeastern extension of the latter.

Brood XII, immediately preceding XIII, is represented by a series of colonies connecting the western Brood XIII with group 5. Brood XIII is the principal representative of group 6 and represents a large western group of the 17-year race of group 6, which comprises the main western branch of the 17-year race, as group 5 clustered about X is the principal representative of the eastern branch of the same race. Brood XIV has a very wide range to the eastward of XIII, and connects with

the latter through the colonies in northern Illinois and Indiana. Brood XV, following XIV, is limited to the Atlantic seaboard with the exception of one doubtful colony in Indian Territory, and connects directly with the eastern colonies of XIV.

Brood XVI is based on somewhat doubtful records, the Colorado locality perhaps being due to confusion with some other species, and the other records needing confirmation. Brood XVII is intermediate between Brood XVI and Brood I, its western colonies connected with the former and the eastern colonies with the latter.

THE RELATIONSHIP OF THE 13-YEAR BROODS.

The broods of the 13-year race break up into the following natural groups: (1) Related closely to Brood XIX, and comprising Broods XVIII, XIX, and XX; and (2) related to Brood XXIII, and comprising Broods XXI, XXII, XXIII, and our new Brood XXIV.

The first of these broods, Brood XVIII, is a rather insignificant one and is undoubtedly an eastern extension or offshoot of the great 13-year Brood XIX, which succeeds it. Brood XX is undoubtedly a section of Brood XIX retarded one year, just as Brood XVI is an accelerated swarm of the same. Both represent eastern extensions of the parent brood.

Brood XXI, separated from Brood XIX by two years, seems to bear little relationship to the latter, and a more logical arrangement consists in connecting it with Brood XXIII through Brood XXII, of which last it may be considered as an eastern and northern extension. Brood XXII is a very marked instance of the formation of a new brood by an acceleration in time of the appearance of a portion of a larger and older brood. Its relationship with Brood XXIII is very marked and can not be questioned. Brood XXIII, the main representative of this group, is followed by the new Brood XXIV, which is evidently a retarded swarm of the preceding brood.

Of the new Broods XXIX and XXX, both of which need verification, no significant relationship can be pointed out.

Brood XXIX is very doubtful, and the records are possibly based on confusion with the 17-year race.

NEW BROODS, 17-YEAR RACE.

Brood XII, 1904.—If his records are correct, this brood is the one referred to by Dr. G. B. Smith as occurring in 1853 in Vinton County, Ohio, and Jo Daviess County, Ill. Its recurrence seems not to have been recorded either in 1870 or 1887, and Smith's records are therefore open to question.

Mr. J. R. Burke, Milton, Cabell County, W. Va., writing under date of May 22, 1897, says: "The Cicada is not due here until 1904; its last visit was in 1887."

Mr. W. S. Herrick, Thurman, Allen County, Ind., writes under date of June 10, 1898, that "We had the 17-year locust in 1887, if I remember correctly." This is also a doubtful record, and it is possible that he referred either to Brood XXII, occurring in 1885, or Brood V, occurring in 1888.

That all these records are open to some doubt is apparent, but they are of sufficient importance to warrant investigation in 1904.

Brood XV, 1907.—This brood is represented by the colony appearing at Tivoli, Duchess County, and Galway, Saratoga County, N. Y., in June, 1890, as recorded by Prof. J. A. Lintner in his Seventh Report, pages 297–301. Mr. Davis records the occurrence of scattering individuals the same year on Staten Island. In a letter of June 2, 1890, Prof. J. B. Smith, New Brunswick, N. J., reports that the periodical Cicada had been taken by several Newark collectors, and had also been observed at Anglesea, Cape May County.

Another record which perhaps applies to this brood is given by Mr. I. N. Smith, Scotland Neck, Halifax County, N. C., in letter of June 22, 1885. He reports that his "First recollection of the locust was about the year 1839 or 1840, when the whole of the white-oak lands were filled with them. * * * In 1855 or 1856 they appeared again, but nothing to compare with the period first stated. The locusts were all on the white-oak land and on the Roanoke River and not on the pine lands." Assuming the dates 1839 and 1856 to be the correct ones, this would throw this swarm of Cicadas into Brood XV, and if there are any representatives left they should reappear in 1907.

The late Mr. W. S. Robertson, of Muscogee, Ind. T., in letter of June 17, 1879, incidentally mentioned also the occurrence of a brood of Cicadas in 1839. This record could not fall in any one of the old broods, and if it belongs to the 17-year race it would be an extreme western outpost of XV.

Brood XVII, 1909.—A very definite record which may coincide with this brood is furnished by Mr. Theodore Pergande, of this Division, who states that Mr. Rosseau, of Charlottesville, Albemarle County, Va., informed him that the Cicada was very numerous in that place in 1875. His informant was positive as to the year from its being the one in which he made a trip to Europe.

Another record is given by Mr. John D. Macpherson, Manassas, Prince William County, Va., in letter of July 3, 1895. He writes: "I came here on the 23d of June, leaving the Cicada in full song in Washington (Brood X). Finding none here, I made inquiry and was informed that they appeared in full force in this county (Prince William) in the year 1875. This information I regard as reliable, the date being fixed as the year following the marriage and arrival of my informant in this county." These Virginia swarms are evidently precursors of Brood I, with which they are therefore closely allied.

A western extension of this brood seems to be indicated in the record furnished by H. J. Giddings, Sabula, Jackson County, Iowa.

He writes, "during last June (1892) the periodical Cicada was quite common here. * * * I thought it was unusual to find them in such numbers four years after their regular appearance. The last regular year was 1888." (See Insect Life, Vol. V, page 200.)

If belonging to the 17-year race, the two records following should also be assigned to this brood. Mr. A. J. Julian, Woolleys Ford, Hall County, Ga., reports under date of June 14, 1898, that the Cicada was present there in 1892. Mr. J. W. Seaton, Strasburg, Cass County, Mo., writes under date of June 9 that the Cicada last appeared in that county in the summer of 1892 and in the summer of 1896, being numerous both years. The 1896 record refers to the 17-year Brood IV, and hence the record of 1892 is probably also of the 17-year race occurring in the same district.

The scattering specimens recorded by Mr. Davis as occurring on Staten Island in 1892 may also be assigned to this brood.

NEW BROODS, 13-YEAR RACE.

Brood XXIV, 1899.—Mr. P. Lynch, Commerce, Scott County, Mo., under date of December 27, 1874, reports that the Cicada appeared in the summer of 1873 in considerable numbers, coming in June and remaining about two months. "Their eastern limit in this county (Scott) was the Mississippi River, but they were as numerous on the opposite side of the river in Alexander County, Ill."

Mr. W. S. Campere, Pickens Station, Holmes County, Miss., writes under date of February 27, 1875, that the Cicadas appeared in great numbers in April, 1873. These two records would indicate a brood originating doubtless by retardation of individuals of Brood XXIII.

Brood XXIX, 1904.—It is possible that the following records apply to a 13-year race, and in that case should be assigned to our Brood No. XXIX.

Mr. C. J. Wellborn, Blairsville, Union County, Ga., writes under date of June 12, 1885, that "in May, 1878, locusts appeared south of this place and the northern limit then was the present southern limit of the territory covered now (by Brood X, 1885)."

Mr. James Pagon, Winnsboro, Fairfield County, S. C., writes that locusts appeared in South Carolina in 1878, but does not give definite localities. Both these records need confirmation.

Brood XXX, 1905.—Mr. B. H. Brodnax, Brodnax, Morehouse Parish, La., writes under date May 13, 1892, that Cicadas are scatteringly present, and in a later letter he asserts that the insect in question is the periodical Cicada, with which he is familiar.

The records given above of new broods of the 13-year race are rather unsatisfactory, and it may be true that the 13-year race has not by any means distributed itself over its entire period, and the broods still cluster about the two main representatives of the race, namely Broods XIX and XXIII.

A CONSIDERATION OF THE VALIDITY OF THE OLD RECORDS BEARING ON THE DISTRIBUTION OF THE BROODS OF THE PERIODICAL CICADA, WITH PARTICULAR REFERENCE TO THE OCCURRENCE OF BROODS VI AND XXIII IN 1898.

By C. L. Marlatt.

SOURCES OF ERRORS IN THE OLD RECORDS.

In examining the records of the distribution of the twenty-one broods of the Periodical Cicada hitherto accepted, it is seen that considerable uncertainty attaches to the data of certain broods, not only from the fact of their covering in greater or less degree territory occupied by both races, but more particularly because the records are frequently based on years in which broods so overlapping have appeared in conjunction. Examining the 21 broods hitherto studied, it will be seen that in each period of 17 years between six and nine years are signalized by the joint occurrence of a 17 and 13 year brood. Owing to the difference in the periods between the recurrences of the southern race and northern race, different broods of both races are being constantly brought into relationship with each other, and in fact the same two broods can come together only once in 221 years. For example, the broods which unite in appearance the present year were last in conjunction in 1697 and will not come together again until the year 2119.

The overlapping of broods thus appearing in conjunction, including some of the more important ones of both races, has given much uncertainty to some of the records. In the case of the broods of the 17-year race, the following extend on their southern boundaries into the territory of the 13-year race, and hence the records of the southern localities are open to some question: Broods VI, X, XIV, XVI, I, IV, to a slight extent also in the case of Broods II and III, and doubtfully in the case of Brood IX, the possibility of confusion in this last brood depending on the accuracy of the extreme northeastern extension of the 13-year Brood XIX.*

The following broods of the 13-year race extend northward into the territory occupied by the 17-year race, and are hence open to some question: Broods XXIII, XVIII, XIX, and XX.

The records can not be questioned of the 17-year Broods VII, VIII, XI, XIII, and V, and of the 13-year Broods XXIV, XXI, and XXII, because these broods are limited in distribution to the territory of a single race.

The most notable instance of the overlapping and consequent probable confusion of the records is seen in the case of Brood X of the 17-year race with Broods XXIII and XIX of the 13-year race. The remarkable feature in the distribution of the broods named is the not-

* See map of races and broods given in Bull. 44, new ser., U. S. Dept. Agric., figs. 2–19 (pp. 25–49).

able extension northward in Illinois and Missouri of the 13-year Broods XXIII and XIX, which fill almost exactly a district which would naturally be supposed to belong to the 17-year race and probably to Brood X. As pointed out elsewhere,* this circumstance has special significance when it is remembered that the northward extension of the 13-year race is based on Broods XIX and XXIII, and that records of the former were collected for the most part in 1868, when this brood was in conjunction with Brood X, and of the latter in 1885, when Brood XXIII was also in conjunction with Brood X, the limits of which curiously enough stop rather suddenly at or near the eastern State line of Illinois. A possibility is immediately suggested that the northern localities assigned to Broods XIX and XXIII properly belong to Brood X. It is true, however, that records obtained the present year in the main seem to sustain the accuracy of the older records, but there is still sufficient doubt to warrant the taking of considerable pains in future to obtain accurate and full records of the distribution on the occasions of the recurrences of the several broods mentioned. Fortunately, in 1902, the date of the next appearance of Brood X, there is no 13-year brood to confuse the records which may then be made.

Many of the other scattering records of 13-year broods northward, or of 17-year broods southward, may possibly be based on similar confusions, arising from the overlapping of broods of the two races.

The only way to accurately define the range of the different broods is to undertake with each recurrence a thorough and systematic investigation of all the territory open to the least doubt. Such work has been repeatedly instituted, and particularly since 1868, and many of the more strictly limited broods have been very carefully recorded and their distribution has been satisfactorily defined. Work of this kind has been done for Brood III in Iowa by Professor Bessey, and for Brood V in Ohio and West Virginia by Professors Webster and Hopkins. Similar work has been done for Brood II in New York and New Jersey by Drs. Lintner and Smith, and for X and XXIII by Riley in 1885, and Brood XIX by Walsh and Riley in 1868.

The value of a thorough and systematic canvass of the territory supposed to be covered by any brood is exhibited in much of the work referred to above, and notably in the case of Brood V studied by Professors Webster and Hopkins in Ohio and West Virginia. In the case of this brood, however, there was no difficulty from an association with any 13-year brood.

WORK UNDERTAKEN FOR BROODS XXIII AND VI IN 1898.

The present year a very careful investigation was undertaken by the writer of the important 13-year Brood XXIII and the widely distributed but less important 17-year Brood VI. By calling into requisition the

* Bull. 14, etc., p. 26.

very numerous county correspondents of the Statistical Division of the Department of Agriculture, and also of the Weather Service, in addition to the regular correspondents of the Division of Entomology, a much more careful and thorough canvass was possible than had ever before been made. The result has been most satisfactory, the range of these two broods being much more accurately defined than ever before.

Several thousand replies were received in response to circulars sent out, many of which were negative—the investigation being extended throughout all States in which there was any likelihood of the appearance of the Cicada, and necessarily covering many counties and districts where the Cicada was not expected. The results of this canvass up to June 20 were recorded in Bulletin No. 14, new series, of the Division of Entomology. A large number of replies were received subsequently to that date, and the corrected list of localities is appended, together with a list of the persons reporting and a brief indication of the nature of the record.

With the exception of the southeastern and northwestern range of Brood VI, most of the records for this brood were of scattering individuals, in many localities only a few specimens being observed. It is quite possible also that the records for Ohio, West Virginia, and Virginia in some cases are based on stragglers from Brood V, which occurred in 1897. Dense swarms of Brood VI were, however, reported from the mountain counties of North Carolina, South Carolina, and Georgia, and the limits of the brood, in this portion of its range, are now determined with fair accuracy for the first time. The reports from the mountain counties of Tennessee and Kentucky belong undoubtedly also to Brood VI. A number of strong swarms of this brood are reported in Wisconsin and several in Illinois. Some of the latter assigned to Brood VI may, however, belong to Brood XXIII. The reports if they may be relied upon from northern Michigan (Chippewa and Houghton counties) and from northern Wisconsin (Burnett, Sawyer, and Washington counties) carry the range of the Cicada farther north than any of the old records.

The reports of Brood XXIII nearly all indicate the occurrence of the insect in enormous numbers. Unfortunately, however, there enters again with this brood some doubt as to the correct reference of some of the localities in Illinois, Indiana, and perhaps northern Missouri, or, in other words, where the territory occupied by the two races overlaps. In most of the records assigned to this brood, however, in the States mentioned the evidence points pretty strongly to the accuracy of the reference. Where there is uncertainty a query follows the county.

The records assigned to Brood VI, in North Carolina, South Carolina, and Georgia, and in western Kentucky and Tennessee, can not be questioned. The counties represented are in the main in an elevated mountainous district, and the fact that the Cicada is of the 17-year race is established by the elevation or by the earlier records.

Local investigations have also been undertaken by entomologists in several States. A report from Illinois has been received from Professor Forbes, adding four or five counties to the records obtained for that State. Prof. J. B. Smith has reported from New Jersey, adding five counties to the records previously obtained. Professor Garman has added six counties from Kentucky not previously reported, all in the eastern end of the State, and belonging to Brood XXIII. Professor Stedman sends an extended record of Missouri counties visited by the Cicada this year, one of which is new to our records.

The detailed reports from the parties named and a few records from other sources are incorporated in the records given below.

The records are summarized by States and counties for each brood. The counties marked with a star (*) indicate those in which the Cicada occurred in one or more dense swarms, in many cases several reports being received from the same county. In the unstarred counties the Cicada was reported in few or scattering numbers, or at least as not abundant. The counties in italics duplicate old records; the counties lacking confirmation by the records of this year are inclosed in parentheses and incorporated with the others.

COMPLETE RECORD, BY STATES AND COUNTIES, OF BROOD VI.

Delaware.—Newcastle.

District of Columbia.—Several localities.

Georgia.—Dade,* Elbert, Floyd, Habersham,* Hall,* Paulding, Rabun,* Spalding, White.

Illinois.—Dewitt,* *Douglas*, Knox, McLean, Montgomery, Scott, Shelby,* Vermilion.

Indiana.—Boone, Brown, Carroll, Grant, Johnson, Laporte, Wells.

Kentucky.—Letcher.*

Maryland.—Carroll, Cecil, Montgomery, Prince George, Washington.

Michigan.—Barry, (Cass?), Chippewa, Genesee,* Houghton,* Kent (?), Macomb (?), Newaygo (?), Ogemaw (?), Otsego,* Shiawassee,* Washtenaw.

Montana.[1]—Choteau, Flathead, Gallatin, Missoula.

New Jersey.—Bergen, Cumberland, *Essex*, Hudson, Hunterdon, Mercer, Middlesex, Morris, Passaic, Somerset.

New York.—Greene, New York, *Richmond*, Schenectady, (Westchester).

North Carolina.—Alexander,* Bladen, Burke,* Buncombe, Cabarrus, Caldwell,* Catawba,* Henderson,* Iredell, Lincoln,* Macon,* McDowell,* Montgomery, Moore, Pender,* Polk,* Randolph (?), Rutherford, Swain,* Transylvania,* Union,* Wilkes,* Washington (?).

Ohio.—(Ashtabula), Carroll, Champaign, Columbiana, Delaware, Madison, Mahoning, Montgomery, Morrow, Pickaway, Shelby, (Summit?), Union, (Vinton?).

Pennsylvania.—Bucks, (Dauphin), (Lancaster), Montgomery, (Northampton and adjoining counties), (Philadelphia, Germantown), *Westmoreland.*

South Carolina.—Oconee.*

Tennessee.—Bradley, Greene, Hamilton, Jefferson, Knox, Meigs, Polk, Sullivan.

[1] No authenticated reports of the occurrence of the Periodical Cicada in Montana have hitherto been obtained. It is interesting to note that Mr. E. V. Wilcox, under date of July 14, 1898, reports that this insect was noticed in small numbers in the counties mentioned from June 15 to July 10, and that in Missoula County some damage was done to young apple trees.

Virginia.—Charlotte, Chesterfield, Fairfax, Powhatan, Prince Edward, (Smyth).
West Virginia.—Berkeley, Hampshire, Jefferson, Mineral, (Ohio, Wheeling?), Preston, Webster.
Wisconsin.—Burnett,* *Columbia,* Crawford, Dane,* Fond du Lac, *Green Lake,** (La Crosse), *Marquette,** *Sauk,** Sawyer, Washburn, Waushara.*

COMPLETE RECORD, BY STATES AND COUNTIES, OF BROOD XXIII.

Arkansas.—*Arkansas,** Ashley, Calhoun, Carroll, *Chicot,** Clark,* *Columbia,** Craighead,* Crawford, Crittenden,* *Cross,** *Desha,** (Franklin), Fulton, Garland,* Hot Spring,* Howard, (Izard), (Jackson), *Jefferson,** Lafayette,* Lee,* Lincoln, Logan, Lonoke,* *Marion, Mississippi,** Monroe,* Newton, *Phillips,** Pike,* Poinsett,* *Prairie,** *Pulaski,* Randolph, St. Francis,* *Saline,** (Searcy), Sebastian, Sharp, Union, Van Buren,* Washington, Woodruff.*
Georgia.—(Cobb, Coweta, Dekalb, Gwinnett, Meriwether, Newton.[1])
Illinois.—*Alexander,** Crawford,* Edgar, Edwards,* Gallatin, Hardin,* *Jackson,** Jasper,* Jefferson, Johnson, Lawrence,* *Macoupin, Madison,* Marion, *Perry,** *Pike,* Pulaski,* *Randolph,* Richland, *Scott,* St. Clair, *Union,** Wabash,* *Washington,* Wayne,* Williamson.*
Indiana.—Bartholomew, Daviess,* Fayette, Floyd, Gibson,* Jackson,* Jennings, Knox,* Montgomery, Owen, *Posey,** Putnam, Ripley, Spencer, Sullivan,* Vanderburg,* Vigo,* Warrick.*
Kentucky.—Ballard,* (Barren?), Butler, Caldwell, Calloway, Carlisle,* Christian, Clinton, Crittenden, Daviess, Fulton,* Grant, *Graves,** Green, Hancock, Hardin, Hickman,* Hopkins, Livingston, Lyon, McCracken, Marshall, McLean, Muhlenberg, Ohio, *Trigg,** Union, Webster, Wolfe.*
Louisiana.—Bienville,* (Bossier), *Caldwell,** Claiborne, Concordia,* *East Carroll,** East Feliciana, *Franklin,** *Madison,** *Morehouse,* Ouachita,* Pointe Coupee,* (Red River), *Richland,** St. Helena, Tallulah, Tangipahoa, Tensas,* Vermilion(?), (Washington), *West Carroll.**
Mississippi.—Adams, *Alcorn,** *Amite,** Attala,* Benton,* *Bolivar,** *Calhoun,** *Carroll,** *Claiborne, Coahoma,** *Copiah,** *De Soto,** *Franklin,* Grenada,* *Hinds,** Holmes,* (Issaquena), Itawamba, (Jasper), Jefferson, *Lafayette,** *Lawrence,* Leake, Lee,* Leflore,* *Lincoln,** Lowndes, *Madison,** Marion, *Marshall,** *Montgomery,** Neshoba, *Newton,* Oktibbeha,* *Panola,** Pike,* Pontotoc,* Prentiss,* *Quitman,** *Rankin,** (Scott), *Simpson, Smith,* Tallahatchie,* *Tate,** Tippah, (Tishomingo), Tunica,* Union,* Warren,* Washington,* *Webster,** Yalobusha,* Yazoo.*
Missouri.—*Audrain,** Barry,* Benton, *Boone,* Callaway, Camden, *Cape Girardeau,** Cedar, *Christian,* Clark (?), Clinton, Cole, Cooper, *Dade, Dallas,* Dent, *Douglas, Gasconade, Greene, Hickory,* Howell, Iron, *Jefferson, Johnson, Knox,* (Lawrence), Linn, Maries,* Miller, Morgan, *New Madrid,** *Osage,** Ozark, Pemiscot,* *Perry,** *Pettis,* Phelps, *Polk,* Pulaski, Reynolds (?), *Scott,** *St. Charles,** St. Clair, St. Francois, *St. Louis, Taney, Texas, Warren, Washington,** *Webster.*
Tennessee.—*Benton,** *Carroll,** *Chester,** *Crockett,* (Davidson), *Decatur,** *Dickson,** *Dyer,** *Fayette,** *Gibson,** *Hardeman,** Hardin,* *Haywood, Henderson,** Henry,* *Humphreys,** *Lake,** *Lauderdale,** Lewis, *Madison,** *McNairy,** (Maury), Montgomery, *Obion,** Perry,* (Robertson), Rutherford, *Shelby,** Stewart, *Tipton,** Wayne,* *Weakley,** Williamson.

[1] None of these localities, all of which were queried, were confirmed in 1898, and the record of this brood in Georgia is undoubtedly erroneous.

LIST OF PERSONS REPORTING THE PERIODICAL CICADA, 1898, WITH BRIEF INDICATION OF THE NATURE OF THE RECORD.

The exact records obtained by this Division relative to the occurrence of Broods VI and XXIII in the early summer of 1898 are given below, arranged under each brood by States and counties. Upwards of 2,000 additional reports were received of a negative character from the States listed below and others, and of these no record need be made; these reports, however, are of considerable value as showing the regions in the States listed and adjoining States in which presumably the Cicada did not occur.

RECORDS FOR BROOD XXIII.

Arkansas:

Arkansas.—J. C. Wilcox, Stuttgart; June 8; plenty; no damage thus far. C. P. Hinman, Arkansas Post; appeared between middle and last of May. S. D. Jester, Wiggs; June 11; appeared near Gillett.

Ashley.—Dr. Ben. H. Brodnax, Brodnax, La.; extending south from Matoka, Ashley County, into Morehouse Parish, La., to Mer Rouge.

Calhoun.—H. L. Lyon, Woodberry; very few; appeared last of April.

Carroll.—J. W. Ash, Carrollton; June 11; few this year.

Chicot.—William B. Streett, Lake Village; June 26; no general appearance; in spots quite numerous; no special damage to vegetation. W. R. Wallace, Carmel; June; have come; also in West Carroll County, La. W. H. Mathis, Grand Lake; June 17; appeared May 1, remained thirty days; no damage. C. F. Wells, Dermott; June 9; numerous, but mostly in patches.

Clark.—L. L. Mock, Smithton; June 13; not so numerous as in 1881, though more than in 1888.

Columbia.—F. M. Strange, Buckner; June 13; few; no damage.

Craighead.—J. C. Broudaway, sr., Jonesboro; June 14; very few; we look for them next year. G. F. Gibson, Gilkeson; June 13; few, hardly worth noticing. J. S. De Jarnette, Mammoth Spring; August 16; numerous in this and other counties along the Mississippi River.

Crawford.—L. B. Byars, Alma; June 9; few.

Crittenden.—W. F. Madding; appeared here between 1st and 15th of May, increasing in numbers until about June 1; now decreasing. J. S. De Jarnette, Mammoth Spring; August 16; numerous.

Cross.—J. Q. Thomas, Vanndale; appeared in great numbers about May 10. Carl Beard, Vanndale; June 18; large numbers; very little damage. J. W. Halk, Cherry Valley; June 10; present throughout the county. W. P. Brown, Wynne; June 10; present, but no damage noticed.

Desha.—W. H. Goutt, Rotan; June 10; few. G. Waterman, Dumas; June 8; full force; came out of ground.

Fulton.—J. S. De Jarnette, Mammoth Spring; August 16; few.

Garland.—S. D. Jester, Wiggs; June 11; reports appearance in 1893 in this section, and says "Some have appeared near Gillett."

Hot Springs.—J. D. Prince, Sanders; June 13; heard a few but none seen. D. I. Hendrix, Ops; June 11; no regular brood; heard three or four only.

Howard.—T. G. Kennedy, Picayune; very few in May.

Jefferson.—N. T. Roberts, Pine Bluff; here by the million; the earth in the timber perforated by them; June 10. A. F. McNeill, Redfield; here in superlative degree; June 8. R. D. McGaughy, Altheimer; May 10; small quantities.

Lafayette.—J. J. Stubbs, Mot, La.; reports occurrence 20 miles north in Lafayette County, Ark; June 14.

Arkansas—Continued.

Lee.—W. O. Hopkins, Vineyard; June 13; large quantities; first time since 1885. Moses Burke, Lagrange; June 11; any amount; here a month; noise deafening. G. O. Pruitt, Sylarsville; June 11; appeared here about May 15. T. S. Thorn, Haynes; June 9; appeared about May 1 in abundance. O. C. Leftwich, Phillips; June 10; great abundance.

Lincoln.—R. D. Boyd, Cornerville; July 12; few during May.

Logan.—Fred. N. Carter, Hobart; June 15; heard one or two, but have seen none yet. J. A. Jarrard, Morrison Bluff; June 11; only an occasional one is heard.

Lonoke.—S. W. Walls, Cobbs; June 15; great numbers about middle of May. W. H. Pyburn, Lonoke; June 8; present.

Marion.—D. Wickersham, Yellville; June 14; small numbers.

Mississippi.—A. Tillman, Athelstan; June 18; large numbers; no damage. W. D. Henley, postmaster, Chickasawba; June 10; great numbers.

Monroe.—T. C. Dawson, Roe; June 14; appeared about May 1; been very numerous; no damage; all gone now. T. D. Chunn, Hollygrove; appeared about May 23; not so numerous.

Newton.—A. F. Casey, Boxley; June 14; very few; not worth attention.

Phillips.—A. M. Scott, Northcreek; June 9; appeared. D. C. Gordon, Helena; June 10; appeared May 23; here now.

Pike.—D. L. Bevis, Murfreesboro; June 15; small brood appeared about May 20.

Poinsett.—W. G. Godbey, Harrisburg; June 8; present, mostly on hill lands; woodpeckers pounce on them; Cicada found 17 feet under ground while digging well; fine fish bait. Bradford & Erchison, Weiner; June 12; none here, but said to be thick 6 miles east of us. R. L. Cowan, Harrisburg; June 8; large numbers.

Prairie.—A. J. Bassett & Co., Hazen; June 8; been here two weeks. C. L. Bowman, Hazen; June 9; here this season, but seems smaller than in 1881 and does not make such a loud noise; don't remember any thirteen years ago, but do in 1881. R. H. Toll, Devalls Bluff; June 10; here last week in May and first in June.

Pulaski.—W. A. Galloway, Jacksonville; June 10; few.

Randolph.—John Antry, postmaster, Alberta; June 11; none seen; few hulls found.

Saline.—C. D. Harris, Hensley; June; here in great numbers.

Sebastian.—J. C. Galloway, Laraca; June 15; only a few seen.

Sharp.—W. F. Stuart, Center; June; few.

St. Francis.—R. W. Payne, Wheatley; June 9; great numbers. M. N. Gaines, Forrest City; June 8; great numbers.

Union.—R. T. Nabors, New London; June 15; only a few.

Van Buren.—J. W. Beavers, Sang; June 10; very scarce.

Washington.—W. B. Fraker, Westfork; few; dozen to the square mile.

Woodruff.—John Shearer, McCrory; June 9; abundant; had them two weeks. W. B. Battle, Beebe; June 8; none here in White County; plentiful east in Woodruff County. W. Movrman, Hunter; June 13; appeared last month; very numerous, but less than in 1885.

Illinois:

Alexander.—Prof. S. A. Forbes, in letters of June 23 and July 2, reports great numbers. S. H. Yate, Willard; June 8; appeared about May.

Crawford.—M. L. Caywood, Odlong; June 8; numerous in timbered section.

Edgar.—G. W. Legg, Scottland; June 18; few coverings found; no live ones.

Edwards.—F. Wick, Albion; June 18; 3 miles east there is a full brood. J. B. Jolly, Grayville; June 20; numerous; knew them here sixty years or so ago.

Gallatin.—M. Doherty, Shawneetown; June 20; few in timber.

Hardin.—W. J. Banks, Karbers Ridge; June 8; heard a few since May 10, but none since storm.

Illinois—Continued.

Jackson.—G. H. French, Carbondale; July 11; have been here in considerable numbers. Edw. Davis, Elkville; June 18; plenty this season; a few for four years past. Prof. S. A. Forbes reports great numbers.

Jasper.—J. Michels, Bogota; June 13; appeared about fifteen days ago.

Jefferson.—O. P. Nesmith, Bluford; June 11; very limited numbers about May 15.

Johnson.—Prof. S. A. Forbes reports great numbers.

Lawrence.—D. Horner, Olney; June 7; timber is full.

Macoupin.—G. W. Bohannan, Chesterfield; few; not so many as in 1881 or 1894. (Forbes.) Recorded in Bloomington Pantagraph, June 21; remarkable amount.

Madison, Marion.—Prof. S. A. Forbes reports great numbers. Recorded in Bloomington Pantagraph, June 21.

Perry.—J. B. Ervin, Swanwick; June 13; appeared May 21.

Pike.—Recorded in Bloomington Pantagraph, June 21. Dr. R. H. Main, Barry; July 18; heard them three or four weeks ago in west side of county. (Forbes.)

Pulaski.—W. R. Crain, Villaridge; June 8; appeared about May 20 and are yet in full force, doing much damage to young orchards. J. W. Gaunt, New Grand Chain; great numbers from latter part of May until June 10. J. S. Morris, Ullin; great numbers; came about May 25. Prof. S. A. Forbes reports great numbers. M. N. McCartney, superintendent of city schools; common at Grand Chain, near Johnson County line; said to be numerous across Ohio in Kentucky. (Forbes.)

Randolph.—Recorded in Bloomington Pantagraph, June 21. Prof. S. A. Forbes reports no great numbers.

Richland.—John Camp, Berryville; June 18; heard one or two; no damage.

Scott.—Prof. S. A. Forbes reports no great numbers.

St. Clair.—F. Helms, Belleville; June 8; heard few in timber; found remains of a few last year. William Galle, Marissa; June 8; not such numbers as four years ago. Otto P. Klopsch, superintendent schools, Mascoutah; heard it early in June; since then but rarely; secured no specimens. (Forbes.)

Union.—J. R. Jarvis, Cobden; June 10; small numbers middle of April; large numbers middle May. Prof. S. A. Forbes reports "large numbers."

Wabash.—A. B. Denham, Cowling; June 9; great numbers; remember them in 1860, 1872 or 1873, and 1885 or 1886.

Washington.—W. L. Kugler, Okawville; not such numbers as heretofore. A. A. Hinkley, Dubois; few; only seen the "casts;" very scattering. (Forbes.)

Wayne.—C. O. Truscott, Cisne; June 6; good many in timber lands.

Williamson.—Prof. S. A. Forbes reports "great numbers."

Indiana:

Bartholomew.—Amos W. Butler, Indianapolis; July 27; heard at Columbus July 24.

Daviess.—W. M. A. Kirby, Bloomington; June 12; none here; but read that they are plentiful in Daviess County.

Fayette.—Jonas Scholl, Lyons Station; June 11; few stragglers.

Floyd.—G. E. Smith, Floyd Knobs; June 6; one here and there.

Gibson.—Anton Zeitz, Haubstadt; June 7; great numbers. J. B. Jolly, Grayville, Ill.; June 9; numerous. Ed. R. Wahnsiedler, Oakland City; June; very numerous; considerable damage. John W. Johnson, Princeton; great numbers about May 25. C. F. Garrison, Fort Branch; June 8; vast numbers in forests; ground perforated with holes.

Jackson.—O. M. Foster, Seymour; June 17; few; not so abundant as in 1885.

Jennings.—H. R. Weeks, North Vernon; June 8; moderate numbers.

Knox.—James W. Emison, Vincennes; June 6; woods are full. R. M. Robinson, Wheatland; June 9; not very numerous. J. B. Jolly, Grayville, Ill.; June 9; numerous. Amos W. Butler, Indianapolis; heard several at Vincennes July 8.

Indiana—Continued.

Montgomery.—M. B. Waugh, Crawfordsville; June 11; here thirteen years ago; few this spring. J. S. Fullerwider, Browns Valley; very few about June 1.

Owen.—J. W. Hart, Quincy; June 6; very few.

Posey.—J. B. Elliott, New Harmony; May 24; appeared May 22; promised to be very numerous. J. Troop, Lafayette; reported two weeks ago as appearing near New Harmony; June 2. Jacob Bicker, Wadesville; appeared May 20 in enormous numbers. William J. Cox, Mount Vernon; June 8; plentiful; about two-thirds of county, northern part, infested. J. P. Jolly, Graysville, Ill.; numerous.

Putnam.—J. W. Robe, Greencastle; June 9; very few.

Ripley.—John Bennett, Sunman; June 6; few.

Spencer.—James Romine, Gentryville; June 7; very few.

Sullivan.—George Goodwin, Sullivan; June 6; abundant. D. E. Everhart, Eagle; June 11; numerous.

Vanderburg.—W. Knerr, Armstrong; June 7; large quantity; "orchids" suffering. John Fridy, Zipp; June 8; appeared. Amos W. Butler, Indianapolis; July 27; heard a few at Evansville July 22.

Vigo.—William Lowe, jr., Terre Haute; June 11; heard of them.

Warrick.—Jacob Martel, Chandler; June 8; large numbers. W. B. Sanders, Newburg; June 9; few.

Kentucky:

Ballard.—J. E. Jones, Oscar; June 9; plenty. W. W. Owen, Hinkleville; June 7; abundant. A. M. Shelby, Bandana; July 23; pretty general, no damage. (Garman.) J. G. Clark, Lovelaceville; July 28; were here by the thousands; stayed but a short time. (Garman.) J. B. Payne, M. D., Ogden; plentiful in river bottoms, etc.; same variety as in 1890 or 1891; young fruit trees damaged. (Garman.)

Butler.—A. A. Chaddock, Berry's Lick; June 13; very few. A. Thatcher, Morgantown; July 22; heard of some. (Garman.) J. R. Ellis, Woodbury; July 18; have seen some. (Garman.)

Caldwell.—J. H. Neel, Kelsey; June 7; small numbers; also in Crittenden and Lyon counties. A. B. Coleman, Princeton; July 16; very few. (Garman.)

Calloway.—Sam. B. Watson, Backusburg; August 3; appeared in great numbers May 1; disappeared by third week in June. (Garman.) A. K. Crawford, Flint; August 7; very few in this part, but great many in southwest part of county. (Garman.)

Carlisle.—O. A. Glass, Arlington; June 12; immense numbers. W. Z. T. Smith, Bardwell; June 7; appeared about May 15; very numerous. Robert L. Cook, Arlington; July 18; great quantity. (Garman.) O. A. Glass, Arlington; July 17; were very numerous. (Garman.) T. E. Hall, Milburn; July 17; very plentiful six weeks ago. (Garman.) B. H. Smither, Grahamville; good many; understand they were very numerous in Carlisle County. (Garman.)

Christian.—J. T. Ford, Crofton; June 21; few. F. B. Hancock, Casky; June 6; very few. (Garman.)

Clinton.—L. P. Duvall, Savage; June 14; heard one or two in the timber on mountains; some apple twigs killed.

Crittenden.—J. H. Neel, Kelsey; June 7; small numbers. J. N. Boston, Levias; July 21; heard a few. (Garman.)

Daviess.—S. H. Jesse, Ensor; June 21; very few. D. W. Howard, Utica; June 15; few; no damage. C. H. Haynes, Ensor; July 17; a few. (Garman.)

Fulton.—James H. Saunders, Hickman; June 11; present also thirteen and twenty-six years ago. D. W. Dickinson, Hickman; millions; immense damage to young trees. (Garman.)

Grant.—J. T. Points, Sherman; June 6; very few.

Kentucky—Continued.

Graves.—Moses Connor, Mayfield; large numbers; June 10. J. P. Morrill, Lowes; June 9; plentiful. T. J. Cross, Pritchard; July 20; no damage; considerable noise. (Garman.) N. S. Allison, P. M., Pryorsburg; July 16; plenty; counted 16 holes in a foot square of ground. (Garman.)

Green.—R. I. Taylor, Thurlow; June 7; few.

Hancock.—John Friel, Victoria; July 1; very few; very abundant thirteen years ago. C. E. Friel, Patesville; "heard them singing;" June 15.

Hardin.—G. K. Tichenor, Sonora; June 11; extremely limited; mere usual yearly quantity.

Hickman.—James W. Blair, Moscow; June 23; appeared about May 1. J. M. Samuels, Clinton; June 13; not very many. (Garman.)

Hopkins.—W. D. Crow, Madisonville; June 10; heard a few. Robt. Almon, Nortonsville; August 8; few; same as last year (annual ?). (Garman.)

Livingston.—J. R. Summers, Salem; June 10; few; here in 1894 in full force. T. H. Robertson, Lola; July 17; few. (Garman.)

Lyon.—J. H. Neel, Kelsey; June 7; small numbers. Essex Spurrier, Star Limeworks; not more than every year (annual ?). (Garman.)

Marshall.—J. B. Wyatt, Briensburg; July 1; considerable numbers in May. (Garman.) W. E. Downing, Sharpe; July 26; a few. (Garman.)

McCracken.—W. N. Bryan, Lamont; July 16; few. (Garman.) B. H. Smither, Grahamville; good many. (Garman.)

McLean.—R. N. Brown, Congleton; few. (Garman.)

Muhlenberg.—Henry Tinsley, Central City; June 25; very few. J. M. Silvey, Dunmor; June 11; very few.

Ohio.—P. L. Wood, Ceralvo; June 13; few. P. L. Wood, Ceralvo; July 19; not numerous. (Garman.) D. B. London, Rosine; July 16; inconsiderable. (Garman.)

Trigg.—G. T. Wallace, Canton; June 8; appeared first week in May. H. C. Vincent. Cadiz; July 18; very few. (Garman.)

Union.—Geo. H. Drury, St. Vincent; July 19; very few. (Garman.)

Webster.—T. A. Stewart, Sebree; July 18; small number; nothing to compare with five years ago (Brood I ?). (Garman.) Thos. A. Vaughn, Golds; very few. (Garman.)

Wolfe.—J. L. Center, Campton; "does appear this season;" June 7.

Louisiana:

Bienville.—C. E. Whitley, Liberty; "they have;" June 7.

Caldwell.—J. S. Chick, Columbia; June 12; great numbers. J. A. Humphries, Kelly; June 21; appeared. Hattie Hough, postmaster, Columbia; appeared about May 15; great many.

Claiborne.—J. W. McFarland, Homer; June 10; few. M. E. Price, postmaster, Homer; June 3; very few; no damage.

Concordia.—B. J. Wade, Frogmore; appeared about May 17.

East Carroll.—James Beard, Lake Providence; June 10; "millions; no damage." C. A. Voelker, Panola; June 9; numerous in East Carroll and West Carroll parishes, and more abundant in Madison and Tensas parishes. Edw. Constant, Atherton; June 8; "greater numbers than I have ever seen before." N. H. Benjamin, Atherton; June 7; large numbers in and adjoining the forests.

East Feliciana.—Joseph A. Stott, Olive Branch; July 1; heard two, seen none.

Franklin.—A. McD. Baskin, Baskinton; present. G. W. Hodge, Crowville; June 11; abundant. J. B. Garcin, Liddieville; vast numbers in May and early part of June.

Madison.—J. T. W. Clellan, Tallulah; June 10; great numbers, kept to the forests. J. M. Herbert, postmaster, Tallulah; May 27; large numbers in forests. C. A. Voelker, Panola; very abundant.

Louisiana—Continued.

Morehouse.—W. A. Collins, Bastrop; June 16; limited numbers in May for a few days. J. M. Stamper, Bonita; June 17; appeared about April 15. Dr. Ben. H. Brodnax, Brodnax; May 9 and 23; extending west into Ashley County, Ark.

Ouachita.—H. W. M. Elnery, Monroe; June 9; great many. C. S. de Graffenreid, Bosco; May 27; great numbers.

Pointe Coupee.—C. L. Andrews, Fordoche; June 9; great many.

Richland.—R. H. Brown, Goshen; large numbers; June 6. A. B Cooper, Archibald; June 8; appeared May 17, disappeared June 8.

St. Helena.—H. C. Newsom, Tinus; June 18; very few.

Tallulah.—A. E. Adams, Tallulah; June 9; appeared in timber lands; no special damage.

Tangipahoa.—R. B. Miller, Ponchatoula; June 9; have had few genuine locusts every year; no damage.

Tensas.—B. F, Bonney, St. Joseph; large numbers in various places. Robert J. Stewart, St. Joseph; June 25; numerous in forests; no damage to crops. C. A. Voelker, Panola; numerous.

Vermilion.—W. W. Edwards, Abbeville; July 6; few this year; do not think they are the 17-year race.

West Carroll.—S. T. Jackson, Forest; appeared April 10, ceased their "humdrum" June 10. W. R. Wallace, Carmel, Ark.; reported in his card. C. A. Voelker, Panola; numerous.

Mississippi:

Adams.—D. G. Ashley, Ashley, Copiah County; June 23; vast numbers.

Alcorn.—J. M. Walker, Kossuth; June 7; great numbers. J. N. Bynum, Rienzi; June 20; large numbers; now disappeared.

Amite.—F. W. Stratton, Liberty; June 8; appeared about May 1; now gone. C. H. Bates, Bates Mill; June 9; great quantities last of April; still here. D. G. Ashley, Ashley, Copiah County; June 23; vast numbers.

Attala.—D. J. Ellington, Sallis; present.

Benton.—C. F. Blakeslee, Hickory Flat; June 5; appeared about May 20.

Bolivar.—Y. E. Howell, Rosedale; June 6; very numerous in some localities.

Calhoun.—C. G. Bentley, Bently; June 12; millions. G. L. Fox, State Spring; June 15; very numerous. Sam Cooke, Walthall; abundant.

Carroll.—S. C. Bains, Vaiden; June 6; appeared about May 10; all gone June 1; quite numerous but no damage. W. A. Reid, Money; June 14; present; also in Holmes and Leflore counties.

Claiborne.—James B. Allen, Port Gibson; June 7; not so many as last year. D. G. Ashley, Ashley, Copiah County; vast numbers.

Coahoma.—M. B. Collins, Jonestown; June 8; appeared about May 12 in great abundance. J. W. Stovall, Stovall; July 6; in force about May.

Copiah.—R. E. Ainsworth, Hazlehurst; June 10; large numbers about May 1. J. C. Smylie, Wesson; June 6; deafening noise in woods. D. G. Ashley, Ashley; May 16 and 23; great numbers.

De Soto.—Jobe Harral, Eudora; June 7; been here two weeks; no damage. J. D. Baker, Olive Branch; June 6; quite numerous in forests; no damage apparently. T. C. Dockery, Love Station; great numbers May 15.

Franklin.—D. G. Ashley, Ashley; June 23; vast numbers. Geo. H. Kant, Meadville; June 10; letter.

Grenada.—O. L. Kinbrough, Grenada; plentiful about May 15.

Hinds.—W. A. Cook, Utica; June 7; here this year; last year 2 miles west. J. A. Newman, Newman; small numbers about middle of April. G. D. Cassity, Terry; June 9; appeared about May 1. Walter Virden, Cynthia; May 22; more numerous than ever known; also in Madison County. D. G. Ashley; vast numbers.

Mississippi—Continued.

Holmes.—F. A. Howell, Bowling Green; June 7; large numbers; almost gone now. W. Bridgforth, Pickens; June 16; very numerous; now gone. W. A. Reid, Money, Carroll County; present.

Itawamba.—J. H. M. Harrison, Tilden; June 15; not so numerous as formerly.

Jefferson.—D. G. Ashley, Ashley; June 23; vast numbers.

Lafayette.—J. F. Brown, Oxford; June 7; present. G. H. Turner, Burgess; superabundance.

Lawrence.—D. A. Dawson, Saulsbury; June 11; small numbers. D. G. Ashley; vast numbers.

Leake.—J. R. Lowry, Hopoca; June 15; few in May; great many in 1881 and 1894.

Lee.—J. W. Burness, Baldwin; June 14; here for a month; in Union County four years ago.

Leflore.—W. A. Reid, Money; present.

Lincoln.—G. R. Robertson, Fair River; June 6; present. D. G Ashley, Ashley; vast numbers. G. H. Kant, Meadville; June 10; letter.

Lowndes.—J. B. Brooks, Crawford; May 1; limited number; large numbers in 1894.

Madison.—W. B. Stinson, Canton; June 11; numbers. Walter Virden, Cynthia, Hinds County; more numerous than ever known.

Marion.—J. M. Foxworth, Pickwick; June 18; reported.

Marshall.—Geo. J. Finley, Holly Springs; June 8; very numerous.

Montgomery.—J. E. Flowers, Kilmichael; June 13; great numbers. J. A. Lane, Huntsville; June 20; very numerous. J. B. Simpson, Poplar Creek; great numbers in May.

Neshoba.—D. H. Thaggard, Philadelphia; very few; very numerous in 1881.

Newton—Eugene Carleton, Decatur; June; not numerous.

Oktibbeha.—O. B. Cooke, M. D., Maben; June 6; large numbers now.

Panola.—T. J. Hunter, Sardis; June 9; singing for two weeks; no damage. R. T. Hunter, Sardis; appeared May 15; disappeared June 6. G. W. Dyer, jr., Batesville; here 1st of April; first I remember. M. T. Wright, Batesville, June 13; here April 10 to June 7. J. F. Williamson, Pleasant Grove; June 6; great numbers.

Pike.—Mrs. L. H. Palmer, McComb; June 6; great numbers; letter of details.

Pontotoc.—J. D. Phifen, Ecru; June 8; very numerous.

Prentiss.—L. M. Burge, Wheeler; June 10; appeared last of April. B. A. P. Selman, Booneville; June 7; some think them not as numerous as former years.

Quitman.—J. A. Cooper, Belen; June 7; very numerous; clipping from "The Quitman Quill," woods alive; June 3.

Rankin.—W. E. Johnson, Chapman; June 20; great numbers in forests during May. J. M. Palmer, Lynwood; immense quantities in some places, in May.

Simpson.—W. G. Ashley, Ashley; June 23; vast numbers.

Smith.—W. G. Ashley, Ashley; June 23; vast numbers.

Tallahatchie.—J. P. Arnold, Rosebloom; June 17; present; no damage.

Tate.—William Scott, Senatobia; June 13; large numbers in timber in May. W. R. Eason, Arkabutla; June 8; good supply.

Tippah.—W. G. Rutledge, Ripley; June 8; here now; no damage. M. T. Gardner, Blue Mountain; appeared about May 20.

Tunica.—Thomas Byrn, Wanamaker; June 8; large numbers. R. C. Kyle, O. K.; has been very numerous.

Union.—R. J. Alexander, Etta; woods alive with them in May. F. W. Cullins, Wallerville; June 17; appeared May 1; disappeared to-day. James H. Hevey, Ingomar; August 22; vast numbers; remained forty-five days.

Warren.—John D. Watts, Redwood; June 7; appeared in the eastern part of county. I. V. Welch, Redwood; June 8; yes.

Mississippi—Continued.

Washington.—W. W. Stone, Greenville; June 22; large numbers; no damage. George Read, Greenville; June 12; present. P. M. Alexander, Hollandale; very numerous during May.

Webster.—Samuel Cooke, Walthall; May 13; great abundance here and in Calhoun County.

Yalobusha.—J. F. Proving, Coffeeville; June 5; large numbers in April and May. J. N. Delk, Coffeeville; June 11; present. T. W. Roberts, Coffeeville; June 10; appeared in April; few still.

Yazoo.—R. V. Powers, Palmetto Home; June 9; large numbers.

All of State from south line to Washington County reported as plentiful by C. A. Voelker, Panola, La., June 9. (N. B.—This is about 125 miles along east bank of Mississippi River.)

Missouri:

Audrain.—J. F. Llewellyn, Mexico, Mo.; June 28; found none, but sends clippings reporting plenty in woods. Rush Hill (Stedman).

Barry.—Peter McNally, Cassville; June 10; present.

Benton.—James Butcher, Zora; few about May 15.

Boone.—Columbia (Stedman).

Callaway.—L. D. Thompson, New Bloomfield; June 22; very few.

Camden.—J. R. Moss, Purvis; heard one. Mary J. Ragg, Nonsuch; June 20; very few.

Cape Girardeau.—J. J. Sawyer, Fruitland; June 10; appeared May 1; disappeared June 10. L. M. Bean, Gordonville; June 9; numerous. Cape Girardeau (Stedman).

Cedar.—W. T. Bayless, Stockton; June 13; few.

Christian.—Sparta (Stedman).

Clark.—James Boley, Ashton; June 15; very few.

Clinton.—W. R. Walkup, Gower; June 26; few.

Cole.—A. J. Davis, Jefferson City; June 14; few.

Cooper.—A. I. Ziegle, New Palestine; June; few. A. G. T. Thomas, New Lebanon; June; have seen two or three.

Dade.—Greenfield (Stedman).

Dallas.—Spring Grove (Stedman).

Dent.—William Barksdale, Gladden; not very numerous.

Douglas.—John Souder, Denlow; June 15; none, only two or three. Cold Spring (Stedman).

Gasconade.—Charles F. Pope, Bland; June 13; not in great number. E. J. Alberswerth, Stony Hill; June 10; very scarce. Bay (Stedman).

Greene.—H. D. Fulbright, Willard; June 16; few. Nichols (Stedman).

Hickory.—Elkton (Stedman).

Howell.—West Plains (Stedman).

Iron.—T. P. Russell, Ironton; June 11; very few.

Jefferson.—De Soto (Stedman).

Johnson.—Holden (Stedman).

Knox.—Novelty (Stedman).

Linn.—C. G. Bigger, Marceline; June 11; one now and again.

Maries.—G. P. Skaggs, Van Clere; June 16; present.

Miller.—H. C. Jackson, Ulman; June 12; limited numbers.

Morgan.—C. N. Mitchell, Gladstone; June 10; small numbers.

New Madrid.—R. S. Mott, Point Pleasant; appeared about May 1. W. H. Marshall, Morehouse; June 9; not in this immediate vicinity, but near. Ristine (Stedman).

Osage.—W. F. McDaniel, Linn; June 11; plenty. Chamois (Stedman).

Ozark.—L. E. Brown, Igo; June 11; few.

Missouri—Continued.

Pemiscot.—J. M. Bullard, Cooter; June 11; large numbers.

Pettis.—Green Ridge (Stedman).

Perry.—A. H. Cashion, Derryville; June 11; present. Claryville (Stedman).

Phelps.—J. M. Fleming, St. James; June 18; few; numerous in 1892.

Polk.—Aldrich (Stedman).

Pulaski.—J. K. Giddens, Big Piney; June 11; few. T. T. O'Halloran, Richland; June 28; few. W. H. Goodman, Hancock; June 11; very few.

Reynolds.—J. E. Heaton; July 6; few.

Scott.—G. B. Greer, Sikeston; June 8; appeared. Commerce (Stedman).

St. Charles.—R. B. Bradshaw, West Alton; June 13; appeared. Gilmore (Stedman).

St. Clair.—J. S. Mannering, Lowry City; June 17; very few.

St. Francis.—R. S. Banks, Bismarck; June 11; few. J. A. Shultz, Farmington; June; few.

St. Louis.—Creve Cœur (Stedman).

Taney.—Cedar Creek (Stedman).

Texas.—Stanford (Stedman).

Warren.—G. H. Martin, Tuque; June 14; few in timber. Holstein (Stedman).

Washington.—J. G. Barlow, Cadet; May 27; plentiful in woods; saplings injured. William Goulding, Hulsey; not many. Summit (Stedman).

Webster.—T. G. Cardwell, Seymour; June; not as many as usual. Niangua (Stedman).

Tennessee:

Benton.—R. B. White, Big Sandy; June 8; "bulk came about June 1." W. H. Evans, Camden; June 17; great numbers; now gone.

Carroll.—E. G. Butler, Westport; June 8; numerous. J. W. McMillin (correspondent Statistical Division), Post; letter of May 23; plentiful.

Chester.—J. C. Miningham, Henderson; June 7; abundant. J. A. Miller, Sweetlips; June 6; appeared May 10; plentiful yet.

Crockett.—W. B. York, M. D., Chestnutbluff; present, but rapidly disappearing.

Decatur.—C. F. Abston, Parsons; June 6; abundant. M. P. Haynes, Oakview; June 15; great numbers.

Dickson.—J. E. Manson, Murfreesboro; June 11; much damage.

Dyer.—W. J. Flatt, Templeton; June 15; millions. J. W. Ledbetter, Finley; June 15; considerable numbers; here thirteen years ago. Louis M. Williams, Newbern; June 7; great numbers. J. N. Parker, Dyersburg; June 6; quite numerous. L. M. Michett, Heloise; June 11; apparently "more than usual."

Fayette.—James H. Cocke, Lambert; June 7; "very thick." J. W. Dongan, Williston (2 cards); were very numerous in May; very few now; June 18. W. A. Douglass, Lambert; June 16; appeared about May 1. J. M. Jones, Somerville; June 7; large quantities.

Gibson.—G. W. Terrill, Nebo; June 10; appeared about May 6. J. H. Koffman, Fruitland; June 11; great numbers.

Hardeman.—A. Fitz, Whiteville; June 9; large numbers about May 10. E. B. Stewart, Newcastle; appeared last of May; stayed two weeks. J. L. Gibson, Whiteville; appeared about second week in June.

Hardin.—E. T. Cronin, Saltillo; June; great numbers. J. T. Martin, Nixon; June 14; very numerous.

Haywood.—F. B. Gause, Nutbush; June 13; appeared May 15; were here in 1885. F. E. Hunt, Stanton Depot; June 11; very numerous.

Henderson.—T. C. Moore, Luray; June 14; present; here in 1885. Nathan Walter, M. D., Atkins; appeared about May 20.

Henry.—J. D. Poyner, Northfork; great quantities from May 15 until June.

Tennessee—Continued.

Humphreys.—George M. Tubb, Waverly; June 8; considerable numbers in some localities; in others none.

Lake.—L. Donaldson, Tiptonville; June 14; appeared end of April.

Lauderdale.—C. S. O. Rice, Orysa; June 8; quite numerous. John Conner, Ripley; June 8; vast numbers; appeared every thirteen years since 1833.

Lewis.—Tom Hale, Napier; June 15; small numbers.

Madison.—John H. Lamer, jr.; June 10; unusually large numbers. W. H. Rochelle, Medon; May 31; great numbers. C. W. Hudson, Malesus; June 13; quite numerous.

McNairy.—G. R. Wilson, Adamsville; June 13; very numerous in May; dying now.

Montgomery.—B. J. Corban, Corbandale; June 23; very few.

Obion.—J. J. Butler, D'Armend; June 11; appeared in Obion County; none in Roane County. W. H. Nichols, Kenton; June 13; "millions." G. R. Holman, Harris; June 9; present.

Perry.—W. H. Lancaster, Lobelville; June 10; great numbers. Elijah Divinny, Lobelville; June 10; now disappearing. M. B. Killrell, Farmers Valley; great numbers.

Rutherford.—J. E. Manson, Murfreesboro; June 11; few in this county; much damage in Dickson County.

Shelby.—R. S. Owen, Dexter; appeared; June. Fred. Buttle, Arlington; June 25; plentiful. R. F. Malone, Capleville; June 8; great numbers; now almost gone. Richard D'Ailey, 36 Equitable Building, Memphis; letter May 30; plentiful; sparrows destroying them.

Stewart.—J. H. Bufford, M. D., Lesbia; June 8; few. G. W. Hart, jr., Bearspring; June 16; few.

Tipton.—S. W. Beddingfield, Gainsville; June 8; great numbers May 10. W. F. Billings, Tipton; June 11; come and gone. H. J. Faught, jr., Covington; June 10; appeared; first time since 1885.

Wayne.—W. D. McAnally, Clifton; June 13; appeared.

Weakley.—W. W. Fuller, Dresden; June 8; large quantities. W. H. Copps, Peck; June 11; numerous; dying fast.

Williamson.—J. F. Buttrey, Naomi; June 8; very few.

RECORDS FOR BROOD VI.

Delaware:

Newcastle.—Frank M. Jones, 1114 West street, Wilmington, in letter of May 30, few specimens found.

District of Columbia:

During the last ten days of May and first of June scattering specimens were found within the limits of the District, chiefly in the grounds of the Department of Agriculture and of the United States National Museum. Just beyond the District limits, near Cabin John Bridge, quite a number appeared, sufficient to allow some boys to collect a half peck of pupal shells. The sparrows snapped up the locusts, however, so promptly that they were not in evidence more than a few days.

Georgia:

Dade.—G. B. Austin, Trenton, Dade County; appeared about last of April; all gone at present date (June 13).

Elbert.—J. F. Scarborough, Elberton; June 7; heard 3 or 4 about May 10.

Floyd.—Isaac D. Gaillard, box 24, Rome; June 30; limited numbers on 19th and 20th of May.

Habersham.—P. W. Green, Turnerville; some; plentiful in Rabun County. J. P. Wilson, Clarkesville; June 7; appeared in some parts of county.

Georgia—Continued.

Hall.—B. Niblack, Virgil; June 22, 1898.

Paulding.—J. S. Watson, Brownsville; June 30; few about first days of May.

Rabun.—See report of P. W. Green under Habersham County; see report of B. C. Hawkins under Macon County, N. C.

Spalding.—H. N. Starnes, Experiment; "advance guard" first heard in Spalding County June 10.

White.—A. W. Smith, Tesnatee; none seen, but few heard recently. P. S. Dorsey, Mossycreek; June 20; very few.

Illinois:

Dewitt.—John I. Barnett, Hallsville; great numbers about middle of May. W. R. Carle, Wapella; millions about first of June.

Douglas.—Recorded in Bloomington Pantagraph, June 21, 1898.

Knox.—Joseph W. Miles, Appleton; heard few June 10.

McLean.—C. N. Vandervoort, Randolph; few this year.

Montgomery.—E. H. Donaldson, Nokomis; very few.

Scott.—John C. Andras, Manchester; sporadic (XVIII, June 2, 1).

Shelby.—Bernhard Manufacturing Company, Strasburg; plentiful in eastern part of county.

Vermilion.—J. G. Baird, Indianola; few.

Indiana:

Boone.—T. R. Caldwell, Lebanon; limited numbers; June 10. J. C. Jaques, Thorntown; reported; June.

Brown.—Thomas J. Cornelius, Cornelius; limited numbers; June 11.

Carroll.—W. B. Ray, postmaster, Rockfield; heard them just lately; June.

Grant.—J. M. Miller, Upland; scattering in the timber; June 8.

Johnson.—John B. Miner, Edinburg; few as yet; June 7.

Laporte.—N. W. Garman, Rolling Prairie; several in the timber; June 13.

Wells.—E. Y. Sturgis, Bluffton; very limited; June 9.

Kentucky:

Letcher.—W. B. Webb, Sergent; present; June —.

Maryland:

Cecil.—Frank W. Sempers, Blythedale; two specimens observed May 25; a year ago larvæ found when excavating at depths of 2, 4, and 6 feet from surface.

Montgomery.—August Busck, Cabin John Bridge.

Prince George.—Frank Benton, Berwyn.

Washington.—H. B. Hawkins, Hagerstown; July 22; saw one specimen; June 1.

Michigan:

Barry.—A. C. Boyes, Hastings; mostly on the forest trees; June 17.

Chippewa.—William P. McDonald, Pickford; plentiful; June 15.

Genesee.—S. W. Pierson, Linden; plentiful; June 6.

Houghton.—John Holle, Jacobsville; very many; arrived in the middle of May; June 11. Also in letter of June 25 John Holle reports great damage, but unable to send specimens.

Kent.—C. L. Barrett, Kent City; appeared in this and adjoining counties, doing great damage; June 10; appeared May 15.

Macomb.—D. H. Miller, Macomb; appeared; July 11.

Newaygo.—W. E. Gould, Fremont; sparingly; few last year; June 16.

Ogemaw.—Malcolm McLean, Prescott; August 29; very small numbers from middle of June to July 30.

Otsego.—H. L. Bonner, Vanderbilt; great numbers, forests nearly denuded; June 8.

Shiawassee.—C. M. Kellogg, Perry; appeared; June 5.

Michigan—Continued.

Washtenaw.—W. A. Easton, Dexter; not so numerous as some years before; June 29.

Montana:

Choteau, Flathead, Gallatin, Missoula.—E. V. Wilcox, Bozeman, July 14; small numbers; some damage to young apple trees in Missoula County. Noticed from June 15 to July 10. (First authenticated report from Montana.)

New Jersey:

Bergen.—William Beutenmuller, American Museum of Natural History, Central Park, New York City; rather common on June 5 at Fort Lee, N. J.; letter dated June 8.

Cumberland.—Edwin W. Starn, Bridgeton; few; abundant in 1895; June 15. Report by Prof. J. B. Smith, July 5, at Vineland.

Essex.—Report by Prof. J. B. Smith, July 5, at Caldwell, etc.

Hudson.—Report by Prof. J. B. Smith, July 5, at Arlington.

Mercer.—Report by Prof. J. B. Smith, July 5, at Titusville, and also on county line between Hunterdon and Mercer.

Middlesex.—George V. Phillips, Franklin; swarms in timbered districts; June June 15. (Also by Professor Smith.)

Morris.—Report by Prof. J. B. Smith, July 5, at Hanover.

Passaic.—J. B. Smith, letter of July 9, at Charlotteburg.

Somerset.—Swarms in timbered districts. George V. Phillips, Franklin Park; June 15.

New York:

Greene.—Hiram Van Slyke, New Baltimore; in limited quantities.

New York City.—Woodlawn Cemetery, James Angus, 1228 Clover street, West Farms; few pupae cases found; letter dated June 15.

Richmond.—William T. Davis, New Brighton, Staten Island; quite generally on east half of island (west half not examined); June 21.

Schenectady.—A. F. Vedder, East Glenville; few seventeen years ago; none here yet; June 10.

North Carolina:

Alexander.—R. Don Laws, Moravian Falls; May 28; extends from Brushy Mountain (see Wilkes County). W. F. Patterson, Mount Pisgah; thick in some places. J. P. Matheson, Taylorsville; not in every neighborhood; June 7. A. P. Matheson, Taylorsville; abundant in some sections of county, in others only a few; May 28.

Bladen.—Charles T. Davis, Populi; many; June 13.

Buncombe.—P. M. Westfeldt, Rugby Grange, Fletcher; abundant in parts of Buncombe and Henderson counties; letter dated June 11.

Burke.—W. C. Ervin, Morganton; abundant; May 26. Also in McDowell County. Herbert O. Houk, Morganton; appeared about; May 1.

Cabarrus.—D. W. Turner, Smiths Ford; few; June 18.

Caldwell.—H. G. Powell, Hibuten; very numerous; June 16. J. M. Spainhour, Lenoir; at Glenburnie; plentiful; letter dated June 8. Rain destroyed thousands. W. J. Harrington, Blackdale; June 6; some south of this place. John M. Houck, Lenoir; in letter of June 13; injury less than ever known before. Frank A. Clinard, Hickory; June 8; present.

Catawba.—Frank A. Clinard, Hickory; June 8; present. George W. Robb, Newton; June 27; appeared in portions of county about May 1. B. M. Morrow, Claremont; June 8; not very numerous except in certain sections. J. W. Killiam, Maiden; appeared in pine woods.

Henderson.—W. D. Miller, Rugby; June 16; present in this township. P. M. Westfeldt, Rugby Grange; June 11; abundant in parts of county. A. Cannon, Horse Shoe; appeared about May 25; the woods are full; June 8. N. H. Hill, Columbus; June 8; numerous.

North Carolina—Continued.

Iredell.—G. H. Shepherd, Elmwood; very limited; appeared May 25, but soon disappeared.

Lincoln.—J. H. Reinhardt, Reinhardt; appeared about May 1, and left about June 1. J. D. Mundy, M. D., Denver; June 11; only a few. R. M. Rumon, Lincolnton; June 6; plentiful, but no damage.

Macon.—Joseph Morgan, Etna; June 13; great quantities. B. C. Hawkins, Highlands; May 21; numerous in the mountains about 2,800 feet elevation; also in Rabun County, Ga., and Oconee County, S. C. C. W. Slagle, Nonah; July 8; present in May.

McDowell.—L. W. Williams, Greenlees; appeared about May 15. S. L. Ballew, South Toe, Yancey County; June; "This year east of Catawba River, next year reach to Blue Ridge, and following year to here."

Moore.—S. B. Worthy, Jonesboro; June 14; very few.

Montgomery.—John F. Cotton, Pontop; June 16; very few.

Piedmont section.—George S. Powell, Asheville; May 23; "Understand it is now appearing in Piedmont section, and is expected in the mountain counties."

Pender.—J. E. Henry, Long Creek; June 6; appeared.

Polk.—C. W. Pearson, Saluda; June 7; appeared about May 1. T. F. Thorne, Mill Spring; June 7; vast amount. N. H. Hill, Columbus; June 8; numerous here, also in Henderson, Transylvania, and Rutherford counties.

Rabun.—B. C. Hawkins, Highlands; in letter June 3; in mountains at elevation of 1,500–3,000 feet.

Randolph.—D. G. McMasters, farmer; few.

Rutherford.—N. H. Hill, Columbus; June 8; numerous.

Swain.—P. P. McLean, Whittier; June 7; present in parts.

Transylvania.—J. M. Thrash, Calhoun; large numbers in May. N. H. Hill, Columbus; June 8; numerous.

Union.—S. J. Richardson, Waxhaw; June 11; some in woods.

Washington.—James A. Chesse, Roper; June 13; "insect in apple trees."

Wilkes.—J. J. Spicer, Joynes; June 9; not here, but in other parts of county. R. Don Laws, Moravian Falls; May 28; "column extending from Brushy Mountains southwest some 28 miles." Calvin J. Cowles, Wilkesboro; July 26; gives boundaries of brood.

Ohio:

Carroll.—Jos. McGregor, Carrollton; very scarce; June 10.

Champaign.—Dr. David O'Brien, Urbana; few; no damage; May 9.

Columbiana.—J. M. Dickinson, Lisbon; none except a few in one locality; July 11.

Delaware.—H. A. Davis, Constantia; June 22; very few.

Mahoning.—L. A. Wagner, Berlin Center; June 9; very few yet.

Madison.—James S. Hine, 248 West Fourth street, Columbus; few.

Montgomery.—James S. Hine, 248 West Fourth street, Columbus; few.

Morrow.—R. A. Beatty, Cardington; June 10; saw two shells.

Pickaway.—Ezra Hill, Darbyville; June 1; few in northern part of county.

Shelby.—J. F. Ernest, Dawson; saw three, May 29; none now, June 9.

Union.—J. P. Martin, Milford Center; limited numbers in particular localities; June 15.

Pennsylvania:

Bucks, Montgomery.—Robert Blight, Green Lane; June 17; great numbers at Durham, Bucks County, and few at Green Lane, Montgomery County.

Westmoreland.—P. Jerome Schmidt, St. Vincent College, Beatty; June 27; seen none; had expected them. Robert Ellis, Youngwood; June 8; few; little early yet.

South Carolina:

Oconee.—B. C. Hawkins, Highlands, Macon County, N. C.; known to be common; June 3. Ernest Walker, Clemsen College; published note in "Keowee (Oconee County) Courier" of June 9, 1898, describing appearance in numbers of Cicada on "Stump House Mountain" (N. C.?).

Tennessee:

Bradley.—J. F. Humphry, Cleveland; June 13; few this year; great numbers in 1894.

Greene.—W. M. Lyle, Beulah; June 7; very few.

Hamilton.—A. W. Duncan, Tyner; June 8; few this year; four years ago "worlds of them."

Jefferson.—George A. Zinkle, Mount Horeb; June 13; have seen none; heard a few.

Knox.—R. P. Rudder, Knoxville; June 15; very few.

Meigs.—W. C. Godsey, Maloney; June 29; only a few. Robert Spalding, Decatur; June 6; very few.

Polk.—N. S. Price, Chesnut Mills; June; few.

Sullivan.—E. H. Barham, Clover Bottom; June 23; in some portions of county.

Virginia:

Charlotte.—I. W. Elam, Terryville; June 8; heard two or three.

Chesterfield.—Peter Traser, Granite; June 11; not in large numbers.

Fairfax.—Theo. Pergande, opposite Cabin John Bridge.

Powhatan.—C. B. Chilton, Jeffersonton; June 10; few.

Prince Edward.—I. H. Booker, Briery; June 10; heard two or three; not expected.

West Virginia:

Berkeley.—G. W. Van Metre, Martinsburg; June 6; noticed about two; not expected.

Hampshire.—J. F. Gardner, M. D., Capon Bridge; few; June 7.

Jefferson.—Joseph D. Smith, Middleway; June 6; found shell of one. J. W. Rider, Halltown; June 7; noticed few stragglers.

Mineral.—J. W. Rinehart, Foote; June 7; few; 17-year brood here in 1885.

Preston.—J. S. Brown, Kingwood; June 7; few; nothing like last year.

Webster.—J. W. Bonner, Camden on Ganley; June 7; heard a few.

Wisconsin:

Burnett.—W. Busch, Spooner; June 10; reported 40 miles from here at Grantsburg, Burnett County.

Columbia.—Prof. E. S. Goff, Agricultural experiment station, Madison; appeared at certain places mentioned.

Crawford.—W. C. Warren, Towerville; June 17; reports of its coming out of ground. "Not at this place. They seem to follow the Mississippi and can be found within 8 miles of it. This place is about 13 miles from river." William D. Merrell, Prairie du Chien; few about May 25.

Dane.—George J. Kellogg, Janesville; July 2; very numerous and injuring the cane fruits; 75 miles of here in Dane County. He adds: "Write Mrs. F. Johnson, Baraboo, Wis., who is making inquiry through our State horticulturist, George J. King." (See Sauk County.) Prof. E. S. Goff reports no indication of them at Madison June 6.

Fond du Lac.—T. F. McConnell, Ripon; June 14; great numbers.

Green Lake.—Samuel Owens, Dartford; June 7; present, but no damage so far. Prof. E. S. Goff states that he is informed by L. G. Kellogg, Ripon, Wis., that they appeared in the town of Green Lake and occasionally elsewhere in State; June 23.

Marquette.—Joseph Whitmore, Harrisville; June 24; here in full force.

Sauk.—Mrs. Franklin Johnson, Baraboo; June 4. Found hundreds just emerged beneath large oak tree; ground in blackberry field thickly perforated with

Wisconsin—Continued.
Sauk—Continued.
holes. In the woods near by their noise resembles the distant roar of the sea. Chicago Times-Herald clipping, June 25, states that they appeared at Baraboo a month ago; much more numerous than seventeen years ago.
Sawyer.—William Powers, Hayward; June 8; few in certain places.
Washburn.—Andrew Ryan, Shell Lake; June 15; not to any extent.
Waushara.—H. O. Kruschk, Auroraville; June 17; some in western part of county, according to report.

SOME OBSERVATIONS ON THE CYCLE OF THE SEXUAL DEVELOPMENT OF THE "BLOOD LOUSE."

(*Schizoneura lanigera* Hausm.)

By S. Mokrzhetski.*

Notwithstanding the fact that *Schizoneura lanigera* Hausm. was the subject of numerous observations in various countries, some stages of its post-embryonic development are still insufficiently investigated and their rôle in the life of the insect is not cleared up. The appearance of the "blood louse" in great numbers in the Crimea gave me an opportunity last summer to turn my attention to those uncleared-up points in the development of the insect and I shall endeavor to lay down briefly my observations.

It is well known that in the blood louse a double cycle of development is observed, one with a sexual generation and the other without it, and that after a number of broods of this insect which are born parthenogenetically from wingless viviparous females—nurses—toward the fall among the wingless male nurses there appear individuals with rudimentary wings, so-called nymphs.

In the past fall in the Crimea I did not find nymphs before September; on the 12th of September (old style) I found in one garden (on the Kacha) nymphs entirely ready to assume the winged state, and on the 14th of September I observed the flying of the winged blood louse. The ability of the winged insect to fly was a matter of doubt in our science. While some investigators (Kessler)† asserted that the winged blood lice move about little and are not capable of spreading the infection on other unaffected apple trees since they are unable to fly over to them, other investigators, among them R. Goethe, ascribed to the winged insect the ability to fly well and to spread the pest to new places.

My observations show that the winged blood louse flies well, but is a bad conveyer of the infection to new places.

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* Translated from the Russian by Prof. P. Fireman, Columbian University, Washington, D. C.

† Dr. H. F. Kessler, "Die Entwickelungs und Lebensgeschichte der Blutlaus." Cassel, 1885. By the same author: "Die Ungefährlichkeit und kostenlose Vertilgung der Blutlaus" in the "Bericht für Naturkunde zu Cassel," 1889.

The period of flight of the winged insects in the present year was very long, having continued a full month from September 14 to October 15. After the middle of October I found no winged insects and no nymphs. All that time the weather was warm, and in the sunny days it was easy to observe the conveyers [of the pest?] possessing well developed wings and flying over the twigs of healthy as well as infested apple trees; on the latter I found the winged louse also sitting at the injured places among colonies of sucking wingless lice, and also on the lower side of the leaves of the apple tree on which the winged louse feeds by making holes in them and sucking them.

On the 14th of September, while riding from Sebastopol to Simpheropol, I caught some winged lice on the window panes of the car. Another time, on September 28, while looking over apple trees on which no wingless blood lice were found, in one orchard near the village Biel, on the Alma, I observed many living and dead winged lice hung up in the web woven by a spider on the twigs of the trees at the height of 7 feet. The nearest infested orchard was situated some 850 feet (about 0.165 of a mile) from the place mentioned, and the winged louse flew over that distance. Later I repeatedly found winged blood lice entangled in webs on such trees where I could not discover any infection by the wingless lice.

In observing the flight of the blood louse in the room under a glass bell jar I had frequent occasion to convince myself that the louse uses well its organs of flying, and is especially lively at noon in the sun. Notwithstanding the ability of the winged louse to make comparatively long flights, it appears, however, a bad conveyer of its offspring to new places. This will be understood from the following observations:

On the 19th of September I cut off some shoots of an apple tree which were strongly infested by the blood louse, placed them in a vessel with water, and covered them with a glass bell jar. After three days I noticed two winged lice, which I placed on a cover glass. (?) On the following day they gave birth to eleven sexual individuals, among which one was a male, while the others were females.

After that, on every following day to the end of September, more and more lice assumed the winged state under the bell jar. I transferred them to the cover glass (?), and on a small apple tree planted into a flower pot and covered by a bell jar. On the lower side of the the leaves the winged females gave birth (the embryos came in the world with the posterior end of the body forward), usually on the second or third day, to seven sexual individuals, on the average. The winged individuals live as much as a week, but the bringing forth of sexual ones stops on the third or fourth day after the assumption of the winged state.

Of the great number of the sexual individuals seen by me the greatest majority were females; to five, sometimes even to ten, females there is only one male.

With such a correlation of the sexes, in freedom, by far not all the females can become fertilized (although one male usually fertilizes two females), and consequently the greater part of them lay their eggs non-fertilized.

Nature having provided the blood louse with a powerful means of preservation of its species, namely, with parthenogenetic multiplication, left the sexual mode of multiplication, as it were, in reserve only (as auxiliary), not having perfected it to the necessary degree.

Thus, although the winged blood lice are capable of flying over to uninfested trees, the sexual females produced by them, owing to a lack of males and the difficulty of finding the females by the latter, lay, in the majority of cases, unfertilized eggs.

The males and females of the blood louse, as is well known, have no proboscis and digestive organs and do not take food during the whole of their life, which lasts, according to my observations, fifteen to eighteen days. In the course of that time the sexual individuals grow, moult several times, and are in constant motion.

The adult female is of a convex, ovate form, yellow red in color, with dark eyes. The antennæ are rather short, five-jointed; the first two joints are the shortest ones; the following three are longer and nearly equal to one another; the last joint is somewhat pointed. The adult female is twice as large as the male; she is 1.1 mm. long, 0.5 mm. wide.

The male is better shaped and quicker in the movements than the female; five-jointed antennæ, about half as long as the body; the third and fifth joints are of about the same size; the fifth one has a hollow and is pointed. The color of the body is olive yellow. On the last segment of the abdomen there are two pointed sexual stripes. The length of the adult male is 0.5 to 0.7 mm., the width, 0.2 mm. Both sexes are covered with a slender white down.

About twelve days after birth the females become slow in their movements. When not at freedom (as in experiments), they gather at the lower surface of the leaves and into depressions of the latter. Through the integument of the adult female begins to shine through a large, long, oval egg, constantly increasing and filling the whole cavity of the female.

About this time the mobile males hunt up the females for pairing; the male gets upon the back of the female, and in this position the insects remain more than an hour. One male fertilizes two, but sometimes more females. Two days after the pairing the female lays its only egg, performing this act slowly during fifteen or more minutes, owing to the enormous size of the egg as compared with the insect itself. The laying of the egg appears as the last act in the life of the sexual female, from which there remains almost nothing more than the shriveled skin, of an olive yellow color, which continues to move for some time.

The egg of the blood louse recalls to one that of the phylloxera. It is oblong, cylindrical, rounded at the ends; freshly laid it is smooth,

shining, yellowish; later on it becomes dark cinnamon (fig. 3), and on it the white down with which the female covers its egg becomes more marked. The length of the egg is 0.5 to 0.7 mm., the width, 0.2 mm.[1]

The first egg was laid, in confinement, by one of the females on the 8th of October, at the lower side of a leaf in an angle of the fibers of the latter. The other females laid their eggs in the hollows of leaves.

In the orchard I investigated the apple trees infested by the blood lice, and on one of the trees found on October 10, among wingless nurses after they have been carefully removed from the twig, two eggs of the blood louse as described above; in other places, i. e., on the leaves or in the bosoms of the latter, or in the depressions of the bark, etc., I did not succeed in finding eggs.

From the eggs laid by the sexual females in a heated room young nurses hatched two months later. It is possible that in nature, in long continued warm weather, nurses are hatched still in the autumn, but the other eggs hibernate until the spring.

Thus, the egg of the blood louse may, with equal accuracy, be characterized as a fall one, as Kessler and Keller do, or as a winter one, as is done by R. Goethe.

A CECIDOMYIID INJURIOUS TO SEEDS OF SORGHUM.

By D. W. Coquillett.

In many portions of the Mississippi Valley the growing of sorghum is quite an important industry; and even when not grown for commercial purposes many farmers raise a sufficient quantity for the requirements of their several households. The plants are raised from seed, and are treated like indian corn, and, although commonly known by the name of sugar cane, are very different from the true sugar cane, the culture of which is confined to the more Southern portion of this country, where the plants are commonly obtained by layering.

On the 2d of October, 1895, two seed-heads of sorghum were received at this office from Mr. C. C. L. Dill, of Dillburg, Ala., and one from Thomas J. Key, of Montgomery, Ala. An examination of these revealed the fact that many of the seeds had been destroyed by the larvæ of some species of Cecidomyiidæ, which had already completed their

[1] Dr. H. F. Kessler, in his extensive work on the biology of the blood louse, "Die Entwickelung und Lebensgeschichte der Blutlaus," 1885, gives, in an appended table of drawings of the various stages of its development, some drawings which do not at all conform with the reality. Thus, in fig. 6 of the table, is represented a nurse giving birth to a young louse, which makes its exit with the head forward, while the young lice produced by the wingless, as well as by the winged insects, come into the world always with the posterior end of the body forward. Further, the drawings of the sexual individuals (of the male and female, figs. 12–13) are entirely incorrect. The egg is represented only diagrammatically (schematisch). In view of what has just been said, we give as accurate a drawing as possible of the egg—female and male—of this plant louse.—S. M.

transformations and escaped, leaving behind them nothing but their cast-off skins to indicate their former presence. With these were several Chalcis flies belonging to the genus Apostrocetrus, which had evidently preyed upon the Cecidomyians.

No complaint of these insects again reached this office until nearly three years later. On September 26, 1898, a second sending of infested sorghum seed was received from R. H. Price, of College Station, Tex. This contained quite a large number of the adult flies in addition to the empty pupa cases out of which they had issued. In several instances these empty cases were projecting out of the tops of the seed-husks, the larvæ having evidently lived in these husks next to the seeds, which they had caused to shrivel up by depriving them of their juices. A large number of the seeds had thus been destroyed by these pests.

An extensive examination of the literature bearing on this subject has failed to reveal a single reference to a Cecidomyian that attacks the seeds of sorghum or of any closely related plant in any part of the world. There is every reason, therefore, for believing that this pest is as yet undescribed, and a detailed description of the adults is given herewith:

Diplosis sorghicola new species.—Antennæ of the male as long as, of the female almost one-half as long as, the body, in both sexes composed of fourteen joints; joints three to fourteen in the female each slightly constricted in the middle, each except the last one greatly constricted at the apex into a short petiole, a few bristly hairs not arranged in whorls scattered over each joint; in the male, joints three to fourteen are each greatly constricted, slightly before the middle, and again at the apex, except in the case of the last joint, the constricted portions are as long as the thickening at the base of each joint; each of the thickened portions bears a whorl of bristly hairs. In the living insect the head, including the palpi, is yellow, antennæ and legs brown, thorax orange red, the center of the mesonotum and a spot crossing the pleura and enlarging on the sternum black, abdomen orange red, wings grayish hyaline. The first vein reaches the costa noticeably before the middle of the wing; third vein nearly straight, ending slightly below the extreme tip of the wing, the basal portion of this vein, where it joins the first vein, distinct; fifth vein forked slightly before the middle of the wing, its anterior fork ending nearly midway between the tip of the posterior fork and the apex of the third vein. Length nearly 2 mm.

Owing to the fact that this insect passes through all of its stages within the seed-husks, there is no chance of destroying it by the use of any known insecticide such as could be used against it with reasonable expense and labor.

A LEAF-TYER OF GRAPE AND ELDERBERRY.

By F. H. Chittenden.

In the summer of 1897, during the first weeks of July, the larvæ of a pyralid moth were observed by the writer at Colonial Beach, Va., on the foliage of cultivated grapevine, occurring in considerable numbers in leaves which they fold together near the middle and join with their rather scanty web. The moth was reared and proved to be *Phlyctænia tertialis* Gn. The short study that was given to this species at the time was incited from its occurrence on grape. Subsequently the larva was found at the same place and in greater abundance upon a

cultivated ornamental plant of the genus Sambucus, called flowering elderberry, and it is obvious that the presence of the insect upon the vine was due in part to the proximity of the latter plant.

I know of no record of this species having previously been found upon grape. In our most recent lists two synonyms are given, namely, *Botis plectilis* G. & R. and *Botys syringicola* Pack. Guenée (Spec. General Delt. Pyral., Vol. VIII, p. 364) gives Vaccinium as a food plant, and Packard (New or Little-known Injurious Insects, p. 250) states that the larva was found in the stem of lilac; hence the name *syringicola* bestowed upon it at that time. It would appear probable from what we now know that this was a very unusual, if not accidental, occurrence, as it does not seem likely that this larva is naturally both a leaf-tyer and a stem-borer of woody plants.

The larva is of a delicate light-green color, with two broad white longitudinal bands extending along the dorsum. When full grown it measures about three-fourths of an inch in length. Just before attaining maturity the ground color is light greenish, but within a few days of pupation this turns to pinkish or flesh-colored, particularly along the dorsum—a phenomenon of common occurrence in this genus.

Such larvæ as were collected began to mature July 12. One which pupated on the 15th issued as a moth on the 26th, having remained in the pupa state 11 days. A second was noticed to form its pupal case July 26 and to transform three days later, the imago appearing August 9. Other divisional records show that the moth issued March 9, 1881, and July 22, 1876, localities unknown.

Comparison of the series recently reared, together with all the material preserved in the National Museum, with a small series of *P. sambucalis* Schiff. from France, in the same collection, show these two species to be so closely related that one might be very readily persuaded to believe in their specific identity. The American specimens are identical with others determined by Professor Fernald as *Botis plectilis*. The European specimens were received from the late M. Ragonot.

The species is recorded or is represented in the national collection and in our Divisional notes from the following localties in this country:

Maine; New Hampshire; Massachusetts; Kendall, New York City, and elsewhere in New York; Pennsylvania (Grote); New Jersey (J. B. Smith); Onaga, Kans. (Crevecœur); Colonial Beach, Va.; northern Illinois (probably in the vicinity of Chicago), and Ohio.

A FLEA-BEETLE LIVING ON PURSLANE.

By F. H. Chittenden.

July 30, 1898, while examining the fruit of melons at Marshall Hall, Md., for evidences of insect attack, an egg mass was observed which from the general appearance of the eggs was believed to be that of a species of Disonycha. The following day the eggs had all hatched.

In the jar in which they were placed, leaves of Chenopodium, Amaranthus and wild purslane (*Portulaca oleracea*) were placed, as these three plants were known to be affected by insects of the genus and were at hand for the purpose. The Chenopodium and Amaranthus were rejected, but the larvæ fed with avidity upon the Portulaca, and in due time transformed to pupa and adult, the species proving to be *Disonycha caroliniana* Fab.*

By the 9th of August the largest larvæ had attained full growth, and on the following day had entered the earth. On the 11th the remainder had buried themselves in the sand with which their rearing jar had been supplied. On the morning of August 17 all but one of these larvæ had transformed to the pupal condition. One imago fully colored and one nearly so, were found on the morning of August 25, having remained in the pupal condition about nine days. The remainder passed the same time as pupæ. The quiescent stage of the larva was six days for the same temperature. The active stage was seventeen to eighteen days, which gives about thirty-seven or thirty-eight days, a figure that represents, in all probability, the minimum period, as the weather averaged about 85° F.

On a previous occasion, July 17, eggs were obtained, which hatched July 22, or in five days.

The egg did not present any character noticeably different from that of *xanthomelæna*, which will be described in a forthcoming bulletin. The larva and pupa, owing to their conspicuous coloration, were strikingly distinct.

The larva.—The larva when full grown is subcylindrical in form, abdominal segments 2 to 7 subequal in width, the others gradually narrowing toward the extremities. Ground color either olive or green, variegated with red, forming with a dark-green medio-dorsal and two submedial stripes, seven longitudinal stripes of alternate green and red. Sometimes red and sometimes green is the prevailing tint. Surface finely granulate, feebly shining. Aside from color the general characters are much the same as in *xanthomelæna*, which has been described in Bulletin No. 22, first series, p. 77. Each segment is produced into a transverse row of ten papillæ, each surmounted by a small black piliferous wart, and terminating in a fine bristle. The first thoracic segment has an additional row of papillæ, and each spiracle is surrounded by a ring of black. Head small, nearly circular, color shining black or very dark brown, triangular space in middle and clypeus brown. The posterior end of the body terminates in a proleg which is concolorous with the surrounding portions of the terminal segment. This is surrounded with two rows of black bristles, one above and the other below. Legs considerably darker than the neighboring portions; sutures and some other portions marked with black, last joint nearly black. Length, 10 mm.; width, 3 mm.

* Mr. F. M. Webster has recorded Portulaca as a food plant of this flea-beetle (Ent. News, Vol. V., p. 41, May, 1894).

Pupa.—From the variability in color of the larva we would expect a similar variation in the pupa. As with the larva there are two prevalent ground tints; in one, rose is the prevailing color; in the other, somewhat greenish orange. Probably these colors represent the similar colors in the larva, rose corresponding to red and orange to olive and green. Aside from color the pupa of this species closely resembles that of *D. xanthomelæna*. The pink or rose-colored form of the pupa has pearly antennæ, elytra, and legs, while the orange type has orange-yellow as the color of the same parts. Length, 6–6.5 mm.; width, 3–3.2 mm.

COTTON FIELD INSECTS.

An esteemed correspondent, Hon. J. D. Mitchell, of Victoria, Tex., on October 1, 1897, set out three trap lanterns in a cotton field near Victoria for one night and sent us the insects so captured. The object of the experiment was to see whether the Mexican cotton-boll weevil (*Anthonomus grandis*), which was injurious in the vicinity, could be captured in this way. The results of the catch are interesting and worthy of record, but it must be premised that not a single specimen of *Anthonomus grandis* was found in the material received.

In all, the catch contained 24,492 specimens, representing approximately 328 species, divided according to groups as follows:

Group.	Specimens.	Species.
Lepidoptera	7,858	75
Hemiptera	7,671	77
Coleoptera	7,659	127
Neuroptera	750	9
Diptera	300	15
Hymenoptera	192	18
Orthoptera	60	7
Total	24,490	328
Spiders	2	.....
	24,492	.....

Divided according to habits, whether injurious or beneficial, the result was: Injurious species, 13,113 specimens; beneficial species, 8,262 specimens; of a negative character, 3,117.

The condition of the material was very poor, since the insects were caught in kerosene oil, and it was difficult, therefore, to determine with accuracy many of the species.

In the Coleoptera the occurrence of *Balaninus obtusus* in great numbers (1,129 individuals) strikes us as very unusual. Over a large part of southern Texas this acorn weevil was very abundant during September. It was frequently attracted to light, and was generally mistaken in Texas for the cotton-boll weevil. The cause for its remarkable abundance can not be surmised.

Most of the moths, as might be expected, were not in condition for specific determination; two forms, however, were readily recognized

and counted; these were the cotton moth, *Aletia argillacea*, of which there were captured 446 individuals and species of Anaphora, mostly *popeanella*, of which there were 1,759. This latter species sometimes injures corn. The remaining species that will be mentioned in the list it was impossible to count.

Among the Heteroptera the false chinch bug, *Nysius angustatus* (103 specimens), and *Calocoris rapidus* (165 specimens) were noticeably abundant.

In the Hymenoptera the number of individuals of each species was not counted and the Diptera were not in proper condition for identification.

COLEOPTERA.

Cicindela punctulata *Fab*	3	Philhydrus perplexus *Lec*	1
Calosoma sayi *Dej*	1	Bryaxis illinoiensis *Brend.* ?	5
Dyschirius abbreviatus *Putz*	1	Decarthron sp	1
Clivina impressifrons *Lec*	7	Myrmedonia n. sp	21
Bembidium intermedium *Kby*	58	Philonthus alumnus *Er*	54
Bembidium versicolor *Lec*	3	Cryptobium texanus *Lec*	2
Tachys pumilus *Dej*	8	Lathrobium longiusculum *Gr*	4
Loxandrus lucens *Chd*	1	Lathrobium collare *Er*	18
Badister elegans *Lec*	1	Dacnochilus angularis *Er*	1
Platynus texanus *Lec*	1	Pæderus floridanus *Aust*	3
Platynus punctiformis *Say*	4	Erchomus lævis *Lec*	9
Casnonia pennsylvanica *Linn*	1	Bledius semiferrugineus *Lec.* ?	2
Galerita atripes *Lec*	1	Bledius nitidicollis *Lec*	1
Pinacodera platycollis *Say*	1	Oyxtelus sculptus *Gr*	1
Zuphium longicolle *Lec*	1	Trogophlœus texanus *Casey*	2
Thalpius rufulus *Lec*	1	Trogophlœus bilineatus *St.* ?	3
Axinopalpus fusiceps *Lec*	3	Phalacrus simplex *Lec*	7
Brachinus phæocerus *Chd*	5	Acylomus calcaratus *Casey*	2
Brachinus medius *Horn*	3	Synchita fuliginosa *Melsh*	1
Stenomorphus rufipes *Lec*	108	Cathartus gemellatus *Duv*	32
Discoderus impotens *Lec*	2	Tomarus acutus *Reit*	2
Harpalus caliginosus *Fab*	1	Typhæa fumata *Linn*	8
Harpalus pennsylvanicus *DeG*	89	Conotelus stenoides *Murr*	7
Harpalus gravis *Lec*	5200	Corticaria simplex *Lec*	3
Selenophorus fatuus *Lec*	1	Pelonomus obscurus *Lec*	2
Selenophorus opalinus *Lec*	1	Elmis ferrugineus *Horn*	1
Selenophorus subtinctus *Lec*	2	Heterocerus gemmatus *Horn*	1
Stenolophus dissimilis *Dej*	5	Anelastes drurii *Kby*	1
Bradycellus rupestris *Say*	23	Agrypnus schottii *Lec*	1
Anisodactylus maculicornis *Chd*	2	Monocrepidius vespertinus *Fab*	2
Anisodactylus agilis *Dej*	2	Drasterius amabilis *Lec*	6
Haliplus lewisii *Cr*	2	Ischiodontus soleatus *Say*	3
Laccophilus 4-lineatus *Horn*	1	Ludius hepaticus *Germ*	1
Bidessus pullus *Lec*	1	Melanotus fissilis *Say*	1
Gyrinus parcus *Say*	1	Pyractomena borealis *Rand*	9
Hydrochus vagus *Lec*	1	Photinus linellus *Lec*	47
Tropisternus nimbatus *Say*	3	Lobetus abdominalis *Lec*	1
Berosus immaculatus *Z*	1	Orthopleura texana *Lec*	1
Berosus exiguus *Say*	3	Hemiptychus punctulatus *Lec.* ?	1
Berosus striatus *Say*	1	Hemiptychus gravis *Lec.* ?	1
Philhydrus nebulosus *Say*	6	Sinoxylon texanum *Horn*	1

COLEOPTERA—continued.

Atænius abditus *Hald*	1	Mordellistena nubila *Lec*	5
Atænius figurator *Har*	315	Mordellistena pustulata *Melsh*	1
Atænius cognatus *Lec*	10	Mordellistena aspera *Melsh*	2
Aphodius sp	1	Macratria murina *Fab*	1
Aphodius lividus *Ol*	14	Notoxus calcaratus *H*	5
Ochodæus frontalis *Lec*	3	Notoxus monodon *Fab*	2
(?) Cyclocephala sp	9	Anthicus floralis *L*	1
Ligyrus rugiceps *Lec*	1	Anthicus vicinus *Laf*	1
Leptostylus biustus *Lec*	1	Anthicus sp	2
Pachybrachys abdominalis *Say*	1	Anthicus sp	1
Myochrous denticollis *Say*	1	Anthicus ephippiatus *Laf*	12
Diabrotica 12-punctata *Ol*	11	Anthicus fulvipes *Laf*	1
Diabrotica balteata *Lec*	2	Pyrota terminata *Lec*	11
Diabrotica vittata *Fab*	7	Epicauta lemniscata *Fab*	199
Haltica ignita *Ill*	15	Macrops obscurellus *Dietz*	7
Systena tæniata *Say*	1	Macrops humilis *Gyllh*	1
Glyptina atriventris *Horn*	1	Pachyphanes discoideus *Lec*	1
Ulus fimbriatus *Cay*	19	Endalus setosus *Lec*	4
Blapstinus pratensis *Lec*	1	Endalus æratus *Lec*	1
Tribolium ferrugineum *Fab*	1	Conotrachelus naso *Lec*	1
Meneceus texanus *Champ*	1	Balaninus obtusus *Blanch*	1129
Oxacis cana *Lec*	1	Tomicus pini *Say*	1
Anaspis rufa *Say*	7		

LEPIDOPTERA.

Aletia argillacea	446	Plagiomimicus pityochromus *Grt*	
Anaphora spp. (mostly popeanella)	1759	Basilodes chrysopis *Grt*	
Hypoprepia fuscosa *Hbn*		Chytoryza orbica *Morr*	
Cisthene unifascia *Gr.* & *R*		Leucania adonea *Grt.* (?)	
Euchætes murina *Stretch*		Noropsis hieroglyphica *Hbn*	
Oeta aurea *Fitch*		Monodes nudicolora *Gn*	
Hyphantria cunea *Dry*		Laphygma frugiperda *S.* & *A*	
Eubaphe brevicornis *Walk*		Caradrina flavimaculata *Harv*	
Eubaphe ferruginosa *Walk*		Hæmatopsis grataria *Fab*	
Exyra semicrocea *Gn*		Fernaldella fimetaria *G.* & *R*	
Matigramma læna *Harv*		Tornis scolopacinaria *Gn*	
Drasteria erechtea *Cram*		Macaria s-signata *Pack*	
Prothymia orgyiæ *Grt*		Stenaspilates meskearia *Hulst*	
Spragueia guttata *Grt*		Hymenia perspectalis *Hbn*	
Acontia lactipennis *Harv*		Loxostege helvialis *Walk*	
Acontia aprica *Hbn*		Titanio nuchalis *Grt*	
Schinia regia *Strk*		Euchromius ocellus *Haw*	
Schinia chrysellus *Grt*		Argyria nivalis *Dry*	

HOMOPTERA.

Cixius stigmaticus *Say*	92	Gypona sp	4
Oliarius sp	11	Gypona sp	2
Fulgorid (gen. ?)	299	Diedrocephala sp	1,700
Delphax sp	24	Tettigonia sp	1
Delphacid (gen.)	195	Platymetopius sp	1
Delphacid (gen.)	2	Eutettix sp	3
Delphacid (gen.)	8	Deltocephalus harrisii *Fitch*	29
Diedrocephala mollipes *Say*	10	Idiocerus sp	2

HOMOPTERA—continued.

Phlepsius excultus *Uhl*	3	Limotettix exitiosa *Uhl*	595
Phlepsius spatulatus *Van D.*	12	Typhlocyba sp	220
Scaphoideus sp	7	Cicadula sp	237
Chlorotettix sp	18	Undetermined (10 species)	604

HETEROPTERA.

Cyrtomenus mirabilis *Perty*	4	Resthenia rubrovittata *Stal*	6
Cydnus obliquus *Uhl*	1	Calocoris rapidus *Say*	165
Amnestes pusillus *Uhl*	138	Megacœlum catulum *Uhl*	1
Thyantha custator *Fabr*	4	Megacœlum (?) sp	1
Harmostes reflexulus *Stal*	5	Lygus sp	127
Corizus sp	9	Lygus sp	1
Nysius angustatus *Uhl*	103	Pœcilocapsus intermedius *Uhl*	25
Nysius pravidus *Uhl*	1	Pœcilocyrtus (?) sp	4
Myodocha serripes *Oliv*	2	Camptobrochis sp	1
Pamera bilobata *Say*	185	Capsus sp	14
Pamera basalis *Dall*	4	Psallus sp	30
Pamera curvipes *Stal*	3	Episcopus ornatus *Uhl*	12
Pamera sp	1	Episcopus (?) sp	2
Heræus plebejus *Stal*	6	Melinna sp	464
Ptochiomera formosa *Dist*	1,108	Melinna (?) sp	1
Microtoma (?) sp	7	Capsid (gen.?)	8
Dolichmerus sp	38	Spilalonius geniculatus *Stal*	10
Anthocorid (Brachysteles?)	907	Pnirontis infirma *Stal*	2
Anthocorid (Lasiochilus?)	1	Pnirontis sp	7
Anthocorid (gen.?)	1	Oncerotrachelus acuminatus *Say*	6
Coriscus sp	2	Corisa sp	7
Trigonotylus ruficornis *Fall*	7	Corisa sp	148

HYMENOPTERA.

Megachile exilis *Cr*		Enicospelus purgatus *Say*	
Photopsis belfragei *Blake*		Rhogas parasiticus *Say*	
Labidus harrisii *Hald*		Rhogas graphicus *Cr*	
Sysphincta melina *Rog*		Rhogas atricornis *Cr*	
Isobrachium rufiventris *Ashm*		Opius sp	
Porizon facialis *Cr*		Blacus sp	
Paniscus geminatus *Say*		Chelonus sp	
Paniscus texanus *Ashm*		Zele melleus *Cr*	
Ophion bilineatus *Say*		Meteorus vulgaris *Cr*	

NEUROPTERA.

Leptoceridæ or caddice-flies (several species)	658	Chrysopa spp	22
		Myrmeleonidæ	10
Ephemeridæ or May-flies (two species)	57	Termite	2

ORTHOPTERA.

Gryllus sp	37	Spharagemon sp	1
Nemobius sp	15	Oligonyx sp	3
Œcanthus sp	1	Undetermined cricket	2
Xiphidium sp	1		

ARACHNIDA.

Plectana stellata *Htz*	2

GENERAL NOTES.

THE INTRODUCTION OF BENEFICIAL LADYBIRDS FROM AUSTRALIA INTO INDIA.

Encouraged by the favorable results which have followed the introduction of certain beneficial ladybirds from Australia into California and later into Hawaii, the United Planters' Association of Southern India, an organization composed chiefly of tea and coffee growers, raised a fund late in 1897, amounting to something over 7,500 rupees (approximately $3,000), for the purpose of making an effort to introduce beneficial insects from Australia which should advantage their plantations.

Mr. Howard O. Newport, himself a planter, was commissioned by the secretary of the association early in January, 1898, to proceed to Australia and to place himself in relations with the Department of Agriculture of Queensland and to make every effort to bring over to India living specimens of desirable species. Mr. Newport sailed on the 30th of January and returned on the 20th of June. His report, which is published in a journal called Planting Opinion of the 16th of July, indicates that he went about his work in a very intelligent and painstaking manner, that he had the hearty cooperation of the authorities of the department of agriculture at Brisbane, and especially the expert advice and assistance of the well-known entomologist, Mr. Henry Tryon. He collected 2,540 specimens of *Orcus australasiæ*, 1,500 *Cryptolæmus montrouzieri*, and 246 *Rhizobius ventralis;* in all, some 4,300 odd insects. A special ice box was constructed and the journey was made without mishap, 30 days elapsing from the day the last insects were placed in the box until the time of opening. The insects were kept at a reasonably uniform temperature of about 25° F., but when the box was opened the insects, although appearing fresh, were without exception dead. The expenses of the trip amounted to about $1,600.

Not discouraged by this unfortunate result, the association at latest advices intends to try it again. They have not, we understand, met with encouragement at the hands of the Indian government, and the venture is purely a private one. It would not be at all surprising if the effort should eventually succeed.

Theoretically, Australian ladybirds should flourish better in Southern India than in California, and it is very probable that *Rhizobius ventralis* will feed with avidity upon the Lecanium scales which affect the coffee and tea plants. The writer is inclined to believe that it will not be found necessary to go to the expense of keeping the insects on ice for a thirty days' journey, even in a tropical region. With plenty of food and a comparatively small number of ladybirds in all stages of existence there is no reason why the insect should not breed during the entire journey. They have been sent in this way successfully in mid-

summer on a twenty-five days' journey from San Francisco to Portugal, and should certainly survive the trip from Sydney to Colombo in the same way.

THE SUGAR-CANE BORERS OF THE MASCARENE ISLANDS.

M. Edmond Bordage, director of the museum of the island of Réunion, has recently published in the Revue Agricole, Saint-Denis, April, 1897, and in the Comptes Rendus des Séances de l'Academie des Sciences for December, 1897, important papers upon the sugar-cane borers of Réunion and Mauritius. In his last paper he shows that *Diatræa striatalis* was introduced from Ceylon into Mauritius in 1848 in cane imported by Sir William Gomm. The cane was known to be infested and was destroyed shortly after being taken from the vessel, but the insects escaped. In 1862 it was again imported in cane brought in from Java. *Sesamia nonagrioides* var. *albiciliata*, a species which lives ordinarily in young sugar cane and which occurs also in Algeria in sorghum and in maize, was introduced into the Mascarenes at some period between 1858 and 1861 from Java and was afterwards carried to Madagascar. He shows that Guenée's *Borer saccharellus* is not the *Pyralis saccharalis* of Fabricius, but must be considered as a synonym of *Proceras sacchariphagus* Bojer. *Diatræa striatalis* Snellen is another synonym of the same insect. He further shows that *Proceras sacchariphagus* is an oriental species, being found in India, Ceylon, Java, Sumatra, in the Mascarenes (Bourbon and Mauritius) and in Madagascar; while *Diatræa saccharalis* is a neotropical form occurring in Guiana, the West Indies, and tropical America generally, having also extended its range northward into the United States.

NOTES ON TICKS.

The following account of observations on the effects of the bite of *Ornithodorus americana* ? seems to me to throw some light on the conflicting statements regarding the bite of the reputed *Argas persicus*. From the observations of my correspondent, Mr. R. A. Plaskett, who resides in the Santa Lucia Mountains, in a district infested by this very local Arachnid, it appears that horses, which are generally bitten just above the hoof, seem not to suffer. The Argas drinks only from three to five minutes and then drops without leaving a swelling. This is unlike the habit of the Ixodes and Trombidium, which will suck for a day or two, frequently causing swelling and suppuration. Generally these are supposed to be the effect of methods used to extract the insect, but occasionally they occur after the insect has left of its own free will, having satisfied its appetite.

Another distinguishing characteristic in the habits of this insect is its dislike of green vegetation. It is always found on the top of dry, leafless twigs or in dust, never amidst foliage as are Trombidium and Ixodes; but this part of my friend's observations has to be taken *cum*

grano salis, as he is not an experienced entomologist, and amidst green foliage it is not so easy to discover a dust-colored insect when it is isolated on the top of a dry twig, whence it lets itself down on the passer-by.

As to the effect of the bite of this species on human beings, the symptoms vary; also the time of suction following the bite. The effect seems to depend chiefly on the peculiar temperament of the victim. This seems to be the case also when we take into consideration the comparative immunities and receptivities in regard to the bite of *Acanthia* (*Cimex*) *lectularia*, Reduvius, and of the different Culicidæ. Mr. R. A. Plaskett has been bitten thrice, and in each case twenty-four hours intervened before fever and swelling set in. The numbness of the bitten parts, which is a characteristic following the bite of Arachnid and Myriopod, and also of some Hymenopterous stings, was not noticed in a single instance.

These observations agree very well with the facts that are in our possession relative to the symptoms attendant upon the bite of the Argas; at the same time they explain the discrepancies in statements of the effect of the bite of the dreaded *Argas persicus*, which seems to be as local as our California insect.

The fatal cases of the *Argas persicus* bite, mentioned by old Herodotus and by Pallas in modern times, may have their origin in malarious fevers which were very common in that district of the Persian province Ghilan, between the Caspian Sea and the Elbruz Mountain, where the Argas is found. The bite of the insect is probably only a coincidence, of course not favorable to the condition of a patient already weakened by malaria. Here in California we have had to face an analogous error in regard to the fatal effects of *Rhus diversiloba*. All the fatal cases were malaria patients who had been sick for a considerable time before they came in contact with the Rhus.

As to the *Argas persicus*, even if its bite is not fatal, the consequences in some cases must be serious enough to induce the inhabitants of Persian villages to change the location of their settlements, as is mentioned in Kotzebue's report of his travels through Ghilan. At the same time this change of location is another proof of the very local distribution of *Argas persicus*. *Argas columbæ* of Europe and the species of our own Santa Lucia Mountains are likewise restricted to limited areas.

Our Santa Lucia species seems to be both diurnal and nocturnal. The *Argas columbæ* of Europe is nocturnal, and its habits closely resemble the common bedbug. The local name of our California species is "Pajaronela," a word evidently derived from the Spanish "Pajaro," a bird, and it would indicate to me a similar mode of life to that of *Argas columbæ*, were not the statements of Mr. Plaskett, founded on repeated observations of this locally very common insect, diametrically opposed to such a supposition.

I hope that the publication of these statements will excite some interest among practical students of entomology and lead to a closer study of those species which interfere with the well-being of our own kind. It may be that a closer study of the facts will furnish data that will explain why the sting of an insect which in some instances is followed by serious consequences, is in others perfectly harmless.

Such data might throw some light on the mysterious play of idiosyncrasies.—H. H. BEHR, *California Academy of Sciences, San Francisco, Cal.*

AN INVASION OF THE LARGER DIGGER WASP.

August 8, 1898, Messrs. Gudewill & Bucknall, of New York City, sent specimens of the so-called larger digger wasp (*Megastizus speciosus*), the well-known enemy of the dog-day harvest fly or cicada, with the accompanying report that this insect had appeared at Tarrytown-on-the-Hudson a few weeks previously and had taken complete possession of a large croquet lawn, a bank alongside of it, and a long piece of gravel path. They had become a nuisance through their habit of excavating their burrows and throwing loose earth into large piles, described as being the size of a soup plate. Inquiry was made as to whether the sting of the insect was dangerous, and instructions were sought for the extermination of the insect in the places which it had invaded.

This wasp had never been observed in that vicinity prior to this year. It would be interesting to learn if it will obtain permanent lodgment in a locality so much farther north than is usually inhabited by the species. It is a well-known insect in certain of the public parks of New York City, and it is common also in some places on Long Island, but we have no available records of its common occurrence farther north than this.

RECENT INJURY BY THE SUGAR-CANE BEETLE AND RELATED SPECIES.

During the last two years, and particularly during the year 1898, extensive injury has been reported to the corn and rice fields of the South by the sugar-cane beetle, *Ligyrus rugiceps* Lec., and the related species, *L. gibbosus* DeG.

May 18, 1897, Mr. G. G. Gray sent specimens of the sugar-cane beetle from Poolville, Union County, Miss., with the accompanying information that this insect was rooting up and destroying the corn in that vicinity.

June 23 of the same year Mr. John Duncan, Louisville, Ky., wrote that this species, specimens of which accompanied his letter, and which were received by him from Arkansas, exact locality not stated, "cuts the corn off just below the top of the ground and is very destructive to young corn from the time it comes up until it is knee-high."

May 20, 1898, word was received from Mr. Harold W. Pring, Hester, La., that this species was doing considerable damage to stubble cane in that vicinity.

A similar letter was received from Mr. E. M. Richardson, Millhaven, Ouachita Parish, La., with complaint of the destruction to corn in that parish, the letter being dated May 22.

November 4, 1898, Mr. Rene L. Derouen, Ville Platte, La., sent specimens of this species, with report that it was very destructive to rice and corn crops of that vicinity, attacking the plants when very young.

The species has been treated somewhat fully in the Report of the Entomologist of this Department for the year 1881 (pp. 128, 129), and in Volume I of Insect Life (pp. 11, 12).

The related species, *L. gibbosus*, was received May 9, 1898, from Mr. Joe Davenport, who wrote that it was playing great havoc with stands of corn in the vicinity of Merrouge, La. The beetles were stated by our correspondent to go down under the surface of the earth and completely shred the cornstalks between the surface and the roots.

A singular instance of injury by this latter species was reported September 23 of the same year by Mr. B. M. Vaughan, Grand Rapids, Wis. The beetles were stated to be working into carrot roots and also into the tubers of dahlias.

A NEW ENEMY TO THE GRAPEVINE IN MEXICO.

Under date of July 1, 1898, Mr. L. de Balestrier, of the editorial corps of the Progreso de Mexico, published at Mexico City, sent specimens of the long-horned beetle, *Heterachthes æneolus* Bates, in its various stages, with report that the species is causing damage to the vineyards of San Luis de la Paz, in the State of Guanajuato. Dr. Larragosa, who sent the specimens to Mr. de Balestrier, wrote of the species as follows:

> The perfect insect, and also the pupa, are generally found lodged in the woody portions or in the medullar canal. It appears that the female deposits her eggs beneath the bark, and the larva, having once forced and gained some size, opens a gallery at the expense of the internal layers of the bark and the external layers of wood, reaching the center of the grape shoot, where it remains until it terminates its metamorphoses. All of the plants attacked perish. The rapidity with which the larvæ bore the wood is remarkable, for one that I observed advanced in two hours one centimeter.

WESTWARD SPREAD OF THE COMMON ASPARAGUS BEETLE.

April 23, 1898, Mr. L. R. Taft, horticulturist of the Michigan Agricultural College Experiment Station, wrote that he had received from Benton Harbor, Berrien County, that State, the asparagus beetle, *Crioceris asparagi*. In response to request, specimens of the insect were sent to this office with the additional information that they were received from Mr. A. J. Kniseley, and that it was a matter of considerable importance, as Benton Harbor and her sister city St. Joseph grow large

quantities of asparagus for the Chicago market. In Bulletin No. 160 of the Michigan Experiment Station, published June, 1898 (page 428), Mr. R. H. Pettit, Assistant Entomologist, records the appearance of this insect in Berrien County, stating that several complaints of its presence and injury were received from that district.

This is the first instance of the occurrence of this insect in Michigan, and, in fact, of its occurrence west of the vicinity of Cleveland, Ohio, if we except its reported occurrence in Chicago many years ago. It was anticipated that this insect would spread by natural means through Upper Austral territory in Ohio and Indiana, and it was something of a surprise to learn that it had reached Berrien County, which is located in what has been considered the Transition life zone. This county is in reality upon the border line of what we know to be Upper Austral territory.

It is somewhat surprising that the species has not been reported as injurious at points intermediate between the vicinity of Cleveland and Berrien County, Mich.

It would now seem but a matter of a few years before this species will be well distributed throughout the neighboring Western States east of the Rocky Mountains, at least in such States as include in their territory part of the Upper Austral life zone.

BIOLOGIC NOTE ON CONOTRACHELUS ELEGANS SAY.

During August, 1897, Mr. F. C. Pratt and the writer, while digging about the roots of certain cultivated and allied plants for different species of injurious root-feeding larvæ, had occasion to pull up several plants of the rough pigweed, *Amaranthus retroflexus*, and in the first of these found numerous larvæ and pupæ of the above-mentioned species in the earth about the stems. The larvæ live upon the underground stems, and in two localities in Maryland that were visited a large proportion of the Amaranthus examined was infested. Larvæ were most numerous on mature plants within an inch or two of the surface, and the stems were considerably eroded where the larvæ were at work. About a dozen or so individuals usually comprised the colony about each plant.

The first larvæ transformed to pupæ August 11 and the first imago appeared on the 18th, having passed six and one-half days in the pupal condition. Larvæ and pupæ, as would naturally be inferred, very closely resemble those of our common *Conotrachelus nenuphar*. A cell is formed for the pupa, but this was of such rude construction that it was not often noticed.

In Bulletin No. 7, United States Entomological Commission (p. 83), Dr. A. S. Packard writes of *C. elegans*, which he calls the pig-nut leaf-weevil: "We have observed this weevil at Providence (R. I.) busily engaged the last of May laying its eggs in the partly rolled-up leaves

of the pig-nut hickory (*Carya porcina*), and, during the process, cutting off the leaves, which hang down, wither, and turn black." This paragraph is copied substantially in the fifth report of the Commission. The late Dr. John Hamilton has also placed hickory on record as a food plant of this species. He says: "Common on hickory, on the leaves of which the larvæ live." (Tr. Am. Ent. Soc., Vol. XXII, p. 376.) The writer has beaten this species from hickory at Ithaca, N. Y., in July. The beetles have been collected about Washington late in May and early in June.—F. H. CHITTENDEN.

A NEW SUGAR-BEET BEETLE.

Under date of January 4, 1898, Mr. Henry C. Barron, of Hagerman, N. Mex., sent specimens of the little leaf-beetle, *Monoxia punctícollis* Say, with the statement that it was doing serious injury to the sugar-beet crop in his locality. Its presence was not noticed until the year 1897. A few of the beetles, locally known as the "French bug," were found on the date given by digging in the earth by the side of a beet to the depth of about six inches. Neither eggs nor larvæ were to be found at this time. Our correspondent states that the beetles lay their eggs on the underside of a leaf, that they hatch in about six days, and that the young larvæ commence feeding at once and continue for nine or ten days, when they dig their way into the ground, and, a few days later, come forth as beetles.

The principal damage is by the larvæ, hundreds being found on a single small plant, which is either consumed or is apparently so injured that it shrivels and dies. This beetle is a maritime species, occurring near the seashore and in saline localities. It is known from Massachusetts to Florida on the Atlantic coast, as well as in California, Colorado, Utah, New Mexico, and Texas. Until the appearance of Dr. Horn's Synopsis of the Galerucini, published in 1893, this species was represented in collections under the name of *Galeruca maritima*. According to Horn, *morosa* Lec. and *erosa* Lec. are synonyms of the same species, and the first description of this insect was published by Say in 1824 (Journ. Acad. Nat. Sci., Vol. III., p. 458; Lec., ed. II. p. 222), as *Galeruca punctícollis*, from Mississippi and Arkansas.

This is the first instance of this insect having been found upon any cultivated plant, and, so far as at present known, nothing has yet been published concerning its larval food plant. Mr. Schwarz, of this Division, has found it living in its larval stage upon the sea blite, *Suæda linearis*, a maritime species, like the insect, and a member of the family Phytolaccaceæ. A congeneric species, *Monoxia guttulata*, was reported injurious to the sugar beet in Oregon in 1890, and was made the subject of a special note by Mr. F. L. Washburn, in Bulletin No. 14 of the Oregon Agricultural Experiment Station—F. H. C.

A LEAF-BEETLE INJURIOUS TO CULTIVATED SUNFLOWER.

August 14, 1898, Mr. M. J. Furlong sent to this office specimens of larvæ and adults of the leaf-beetle, *Chrysomela* (*Zygogramma*) *exclamationis* Fab., with information that it was doing injury to cultivated sunflower at Fisher, Minn.

August 25, our correspondent, in response to request, made another sending of the insect, with the statement that it was also found on sunflower at the Minnesota Subexperiment Station at Crookston about two weeks previous to this writing. At this place it was controlled by hand-picking. It was anticipated that it would be necessary to "fight" the insect at Fisher early next year if it should reappear at that place. The beetles went into the earth as soon as received, although larvæ were still living at the time.

I am unable to find any reference to the habits of this species in any of the literature which I have consulted. Among the notes of the late Dr. Riley, however, I find that it was taken commonly in the larval and adult conditions on wild sunflower all through Texas, Indian Territory, Kansas, and Colorado. Larvæ of all stages were observed during August, 1873, always crowding head downward between the leaves when at rest, while the beetles were just coming out of the ground at this time. Dr. Riley also took larvæ and beetles at Greeley, Colo., in July, 1877.

In the writer's collection, this species is represented also from Montana and New Mexico, and it is recorded from Arizona.—F. H. C.

RECENT INJURY BY BARK-BEETLES—A CORRECTION.

During the past two years much injury has been reported by bark-beetles of the genus Dendroctonus to pine and other coniferous forest trees in different parts of the Northern States, from New England to Montana. Notice of injury by *Dendroctonus rufipennis* in New Hampshire was published in Bulletin 10, n. s., of this Division (p. 98), and was again referred to in Bulletin 17 (pp. 67–69), the identification of *D. rufipennis* having been attributed to the writer.

On looking through our Division records, I find that this is an error, as the bark-beetles seen by me from the infested locality were of a different species. This species was received from West Stewartstown, N. H., July 28, 1897; while that identified as *rufipennis* was from Colegrove, N. H., June 5, of the same year. The question of the identity of the species of Dendroctonus concerned in this damage is now receiving attention at the hands of Dr. A. D. Hopkins, and until further study is made of the matter it will be premature to write concerning the species at work in the different localities. It is apparent that several undescribed forms are present in the infested region, either as secondary or primary enemies.—F. H. C.

AN INTERESTING CASE OF MYIASIS.

There was received in February, through the Smithsonian Institution, a specimen of a large maggot from Dr. H. H. Thorpe, of Liberty Hill, Tex. This maggot, according to Dr. Thorpe, cut its way through and came out of the scalp of a child about eight years old. One, still smaller, cut its way out at the hip several weeks previously. As described by Dr. Thorpe, there was first a swelling on the side of the neck and high fever. The swelling gradually passed up the side of the head, disappearing below, until it reached the top of the head. When the maggot cut through the scalp and was taken out the swelling at once subsided.

Similar cases have been brought to the attention of this office on two former occasions. Dr. J. M. Shaffer, of Keokuk, Iowa, wrote us, under date of March 17, 1886, sending just such a larva, which was taken from the back of a boy and exhibited at a meeting of the local medical society. There were said to have been a number of curious spots or small abcesses in the boy's back, and in each of these was found such a maggot. In January, 1893, another similar maggot was received from Dr. T. B. Richardson, of Oroville, Cal., which had been squeezed from the scalp of a child.

The larva from Dr. Thorpe is a trifle over half an inch in length, and closely resembles the third stage of the larva of *Hypoderma lineata*, the common "ox bot" of this country, known locally in Texas as the "heel worm." This insect, although occurring so commonly in cattle, attacks human beings very rarely. The only recorded instance known to us is recorded in Insect Life, Vol. II, pp. 238–239, and Vol. IV, pp. 309–310. The latter reference calls attention to an article by W. M. Schoyen, the Government entomologist of Norway, who states that such cases are occasionally known in Sweden, and are there referable to *Hypoderma bovis*.

THE EUROPEAN BAT BUG IN AMERICA.

There is in Europe a close ally of the domestic bedbug known as *Acanthia pipistrelli*, which occurs upon bats. It has been supposed that this insect might occur in this country, but it has never before been recorded, so far as we know. In July, however, a specimen was received from Mr. J. S. Holmes, of Bowman's Bluff, N. C., which he took from the common bat known as *Nycticejus crepuscularis*, which agrees perfectly with the description of the European *Acanthia pipistrelli*.

A RADICAL NOVELTY IN CHINCH BUG WORK.

In the latter part of July, 1898, in several beautiful lawns in the city of Brooklyn the grass was observed to turn brown in large patches. Close examination showed that a small bug was present in numbers, specimens of which were sent to this office by Mr. Lewis Collins, the secretary of the Tree Planting and Fountain Society of Brooklyn. A

glance showed that the insect was the true chinch bug (*Blissus leucopterus*). That this species should suddenly appear in injurious numbers in the midst of a densely populated city at a point hundreds of miles away from the region of any previous outbreak, and in a summer marked by an unusual rainfall, and upon lawns kept closely cropped and frequently watered, was a phenomenon of striking interest which completely upset all preconceived ideas of what this destructive species is liable to do.

The writer visited Brooklyn early in August, collected specimens, studied the conditions, and returned to Washington strongly impressed with the unusualness of the phenomenon. No specimens of the insect could be collected by industrious sweeping or careful exploration at any point except in the immediate vicinity of the brown patches of lawn grass. On August 5 the insects had begun to migrate, and kerosene emulsion was so effectively applied that within a few days there was no further damage. The bugs were present in enormous numbers, all full grown, about one-third being of the long-winged form, and two thirds of the short-winged. No signs of disease were noticed, in spite of the unusual moisture conditions, which, when we consider the abundant rains of the summer and the frequent waterings of the lawns, is probably unprecedented in the history of the species.

The only previous destructive chinch bug outbreak in the State of New York of which there is record is that of 1882, in fields of timothy grass in St. Lawrence and adjoining counties in the far northern part of the State. The Brooklyn occurrence is to be attributed either to an accidental introduction into the heart of the city from the seacoast, or to an unusual multiplication of a species always present in small numbers; but why should this unusual multiplication have taken place in the face of conditions which, in the West, have always proven destructive to the species?

POISONED POTATO SLICES FOR ONISCUS.

A most admirable result of the use of slices of potato poisoned with Paris green in greenhouses to destroy the sow-bugs, or pill-bugs, which are frequently brought in with soil and damage tender plants, has recently come to our notice. An extensive lettuce grower in Michigan (Mr. A. Loeffler) applied to us for a remedy against these creatures, which he said had already damaged his crop under glass to the extent of $400, and we advised the use of the potato trap. He had four houses, each 20 by 100 feet. He sliced good, juicy potatoes, and his men placed a slice to about every other lettuce plant. He followed with a small blower loaded with Paris green and puffed it on the slices while they were in place. It took two days to make arrangements. As night came on, the sow-bugs emerged from their hiding places, but instead of going to the lettuce as usual, they all made for the sliced potatoes. He returned about midnight and found from six to eight sow-bugs upon each slice of potato. In the morning, as he expressed

it, "everything was bugs." The soil, the edges of the benches, under the benches, and the walks were all covered with the dead creatures. At a rough estimate he concluded that he had destroyed about 24,000 specimens in the two nights.

NOTES FROM CORRESPONDENCE.

For House Ants.—Mr. M. C. Mohr, of Lealman, Fla., writes, under date of September 5, 1898, that a good way to prevent ants from ascending the legs of tables, food safes, etc., is to take an ounce of corrosive sublimate, mix it with a tablespoonful of lard, and apply it in bands of from one-half to three-fourths of an inch wide, seeing that the tables, etc., touch nothing except with their legs. This should be applied every three or five months.

Injury by the Orange Leaf-Roller.—Under date of January 21, 1898, Mr. William Chappelow writes that the so-called orange leaf-roller (*Tortrix citrana* Fern.), specimens of the larva of which he sends, is doing injury to oranges in the neighborhood of Monrovia, Cal. The principal source of damage by this species is due to the habit of the larvæ of burrowing into green oranges, which causes them to turn yellow prematurely and finally to drop from the tree. A short account of this species has been given by Mr. D. W. Coquillett in Divisional Bulletin No. 32, page 24.

Injury by the Caterpillars of Scepsis fulvicollis Hbn.—June 26, 1898, Mr. W. L. Simpson wrote that the above-named caterpillar, specimens of which he sent, was proving very destructive to swamp meadows at Jackson, Wyo. It confined itself chiefly to the lower bottoms, cutting the grass to a level with old stubble and eating it entirely away.

Poisoning for the Cotton Caterpillar.—We learn from Mr. John J. Dix, Benavides, Tex., that in his part of the country contractors treat cotton fields for the ordinary cotton caterpillar (*Aletia xylina*) at the rate of 25 cents per acre, using either Paris green, London purple, or arsenic. This insect is no longer a serious factor in cotton growing. It is generally considered in Texas that if a planter loses his crop as a result of the work of this species it is due to carelessness or laziness.

Insect injury to Pecan Buds.—During the first week of August, 1898, specimens were received of a larva found feeding upon leaves of pecan. Messrs. W. H. McLeod & Sons, of Seabrook, S. C., who sent the specimens, wrote, under date of July 27, that some insect was at work destroying the buds of pecans at that place, and that 400 trees had been destroyed that season. The larvæ sent were reared and proved to be a Tortricid known as *Proteopteryx deludana* Cl. It could not be ascertained whether or not this species was in any way concerned in the injury, but it is, we believe, the first recorded rearing of this species on pecan.

A late Outbreak of the Army Worm.—The present autumn Mr. Frank W. Troth, of Accotink, Va., found the army worm very abundantly at work in his millet when he cut it on the 26th day of September. This is an exceptionally late occurrence of this insect in injurious numbers, and the caterpillars are undoubtedly to be referred to the third generation for the year, counting the offspring of the overwintering larvæ as the first generation. It used to be considered that the first generation of the larvæ only was the injurious one, hence the interest attaching to this instance.

Extraordinary abundance of Io Caterpillars.—We have received from Dr. Ben. H. Brodnax, Brodnax, Morehouse Parish, La., specimens of the larva of *Hyperchiria io* found upon cotton, with the information that he had found thousands of them in the same patch where they were eating leaves and squares and were so abundant as to clean the plants. This insect has long been known as an enemy to cotton, but we have never before received a report of its occurrence in such abundance.

Another very Beneficial Ladybird.—The coffee plantations of Guatemala have been seriously affected for several years by one of the common mealy bugs, *Dactylopius citri*. Efforts have been made by persons interested to secure colonies of

Cryptolæmus montrouzieri, the ladybird which cleared the coffee plantations of Hawaii from an allied scale insect; but, in the meantime, as we are informed by Senor Dieseldorff, of Coban, a native ladybird has developed in good numbers and has practically freed most of the coffee trees from the scale insects. This insect, of which he has sent us specimens, is *Orcus cæruleus* Mulsant, previously known from Brazil, Chile, and Central America.

Leaf-Beetle Injury to Coffee Trees in Guatemala.—June 1, 1898, specimens were received of species of *Noda cretifera* Lef., and an unidentified species of the same genus from Mr. E. P. Dieseldorff, Coban, Guatemala, with the information conveyed in a letter, dated May 19, that they were doing harm to coffee trees in that vicinity. This information was received from Mr. Javier Grijalva, who wrote: "About twenty days ago a strong wind storm passed this plantation, and soon afterwards we noted a great quantity of insects (of which herewith a few examples) which suck the coffee leaves by making numbers of holes in them, thereby causing that they dry up completely."

The Giant Twig Girdler.—We have received from Mr. J. E. Duerden, curator of the Institute of Jamaica, Kingston, Jamaica, a specimen of *Oncideres amputator* Fabr., with a branch which it had amputated. According to Mr. Duerden this insect cuts off branches of the cotton tree (*Eriodendron anfracticosum*), the Congo pea (*Cajanus indicus*), and the horsetail (*Casuarina equisetifolia*). This species is very much larger than any of our native girdlers, and the branch sent by Mr. Duerden has a diameter of $1\frac{3}{8}$ inches, the incision made by the beetle measuring three-eighths of an inch all round.

Recent Injury by Blister Beetles of the Genus Pomphopœa.—March 17, 1898, specimens of *Pomphopœa texana* Lec. were received from Dr. J. D. Burch, of Aurora, Tex., with the accompanying report that the species had suddenly appeared at Rhome, 2 miles from Aurora, on peach trees in bloom. In a brief time not a specimen remained and the beetles then departed for some neighboring plum trees. This is, as far as we know, the first reported instance of damage by this species.

Mr. D. L. Rozzell reports *Pomphopœa ænea* as injurious in March, beginning about the 15th, in 1898, in the vicinity of Short Mountain, Tenn., attack being observed on the bloom of peach, which was eaten entirely off the trees under observation. The beetles were reported to come in swarms like bees. When the trees were jarred they dropped to the ground and flew back to the tree again later.

Swarming of Western Willow Flea-beetle.—We have received a number of specimens of this insect, which is *Disonycha quinquevittata*, from Mr. Herbert Brown, of Yuma, Ariz. Mr. Brown writes that on October 18, from 2 to 3 p. m., an immense swarm of these little beetles passed up the Colorado River. They held to the channel of the stream, and there appeared to be a belt of them about 20 to 25 feet thick and about the width of the stream. They flew probably 50 feet above the water. When Mr. Brown's attention was first called to them, he thought it was an immense swarm of bees. This is a most interesting observation and nothing like it is on record for this species. It seems that the ordinary cause of migration, namely, lack of food, could not hold in this instance, and we are not informed as to whether the peculiar sultry condition of the atmosphere which sometimes induces swarming in other insects was present.

New Food Plants of the Oil Beetle, Meloë angusticollis.—August 31, 1898, Mr. Charles M. Shafer, of Rogers, Ohio, sent specimens of *Meloë angusticollis* found feeding upon two species of touch-me-not, or jewel weed, *Impatiens biflora* (*fulva*) and *Impatiens aurea* (*pallida*).

The Flat-headed Apple-tree Borer Damaging Quilts.—October 6, 1898, Mr. Edw. B. Varney, Fall River, Mass., wrote that the larva of the flat-headed apple-tree borer, *Chrysobothris femorata*, specimens of which he mailed to us, was found at Stevens Mill in that city after these larvæ had damaged several quilts by eating into them. They had evidently come to the mill in lumber from which cases were made.

Cosmopepla carnifex Attacking Mustard.—Mr. M. J. Furlong, of Fisher, Minn.,

writes under date of July 17 that this species, specimens of which were sent, was attacking yellow mustard (*Brassica sinapistrum*) this year in that vicinity. Plats that were attacked early while they were in blossom did not perfect any seed. The sap was sucked from the leaves.

August 14, our correspondent stated that injury had been noticed prior to the present year, but that the insect had never been so numerous. In all cases when the mustard was attacked when about a foot high, the leaves dropped off and the plant died. If the plant was full grown, or nearly so, the insect had less effect upon it. Our correspondent had not seen this insect upon any other plant of the mustard or any other family.

The Big Bed bug of the Far West.—August 15, 1898, Dr. G. W. Harvey, of Salt Lake City, Utah, sent specimens of *Conorhinus protractus* Uhler, with the information that the species inhabits houses and barns of the southern part of that State. It is said by some to be an enemy of the bedbug, killing every one that is found, but this is not yet verified, although our correspondent admits that it may be true. The species closely resembles the so-called blood-sucking cone-nose, or big bed bug, *C. sanguisuga*, of the middle western States, and doubtless has very much the same habits and life history.

Nysius californicus Injurious to Lettuce.—August 9, 1898, Mr. Luca Descalsi, of Santa Rosa, Sonoma County, Cal., sent specimens of this species, which is a near relative of the so-called false chinch bug, *Nysius angustatus*, with the accompanying information that the species was injurious to lettuce in his vicinity. Our correspondent stated that he was able to raise nearly as many of the insects as of salad seeds.

Leaf-hopper injury to Potatoes.—July 13, 1898, Mr. Millis Knickerbocker, New Lenox, Ill., sent specimens of the leaf-hopper, *Empoasca viridescens*, with the accompanying information that it was destructive to potatoes in that section and had been injurious for several years.

The Hawthorn Tingis injuring Quince.—August 17, 1898, we received at this office from Mr. S. S. Wilson, of Libonia, Pa., specimens of *Corythuca arcuata* Say., with the report that it was injuring the leaves of quince in that vicinity. The leaves sent with the specimens showed primary injury by the common pear slug, and the Tingitid was therefore all the more injurious. About 75 trees were affected, and injury was spreading. Fear was expressed that the entire orchard might be ruined. This species was treated in the Report of this Department for 1879, pp. 221–222, and is figured at Plate IV, figures 2 and 3, of the same report.

The Wheat Thrips injuring Plums in Florida.—March 31, 1898, Messrs. McLean & Co., sent us from Conant, Fla., specimens of *Thrips tritici* Fitch, with the report that this insect had caused injury to the plum crop on their farm of 500 trees for six years, the insect being most abundant and injurious on the so-called "Satsuma blood." Other varieties of plums appeared to escape injury, owing to their blooming earlier. Injury begins with the first blooming of the trees, and the blossoms are soon destroyed. An average of 20 individuals were counted on a single bloom.

The so-called "Cotton Flea."—Through the kindness of the Hon. J. D. Mitchell, of Victoria, Tex., we have learned that the delicate little Capsid plant-bug known as *Psallus delicatus* Uhler, is locally known in Texas cotton fields as the "cotton flea." Mr. Mitchell writes concerning their work during the past season that they commenced upon the cotton as soon as it was ready to bloom, about May. They slacked up in July and disappeared about the middle of August. According to our correspondent, they go into the end of the growing limb and suck the juice from the embryo buds, which turn black and fall off as soon as they grow out far enough. The evidence concerning this statement is circumstantial, as the insect itself has not been observed at work. In all fields where these insects were numerous, not a bloom appeared; where they were not numerous a few flowers matured; and since the insects disappeared those fields bloomed out fully. Only certain sections were attacked; so far as observed, only sandy fields were infested.